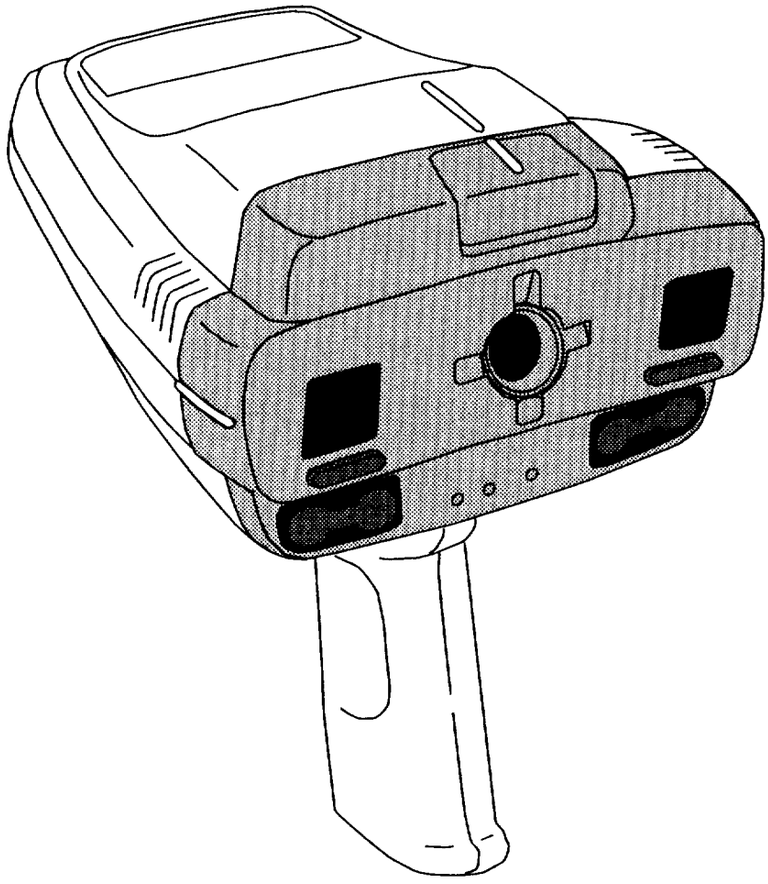
Nikon

Nikon Retinomax K-plus

Instructions



NIKON CORPORATION
TOKYO, JAPAN

Foreword

Thank you for purchasing the Nikon Retinomax K-plus.
The Nikon Retinomax K-plus adds the function of autokeratometer to the Retinomax, a hand-held type autorefractometer.
Do not use this instrument for the other purposes than objective refraction measurement and cornea radius curvature measurement.
The Nikon Retinomax K-plus is a high quality, sophisticated instrument and when used correctly will provide years of accurate trouble-free use.
For proper operation, when using the Nikon Retinomax K-plus, carefully read this manual.
After reading, keep this manual in a conveniently located place for quick reference.

Be sure to read the precautions for operations in Page 3 carefully.

Notes

(1) No reproduction in any form of this manual, in whole or in part (except for brief quotation in critical articles or reviews), may be made without written authorization from NIKON CORPORATION.
(2) The information contained in this manual is subject to change without notice.
(3) If you find any discrepancy, error or omission herein, please notify your dealer of it.
(4) Notwithstanding the above paragraph (3), Nikon shall not be liable for incidental or consequential damages resulting from the use of this product.

Table of Contents

1. Precautions for Operations 3
   1) Safety Precautions 3
   2) Environmental Requirements 4
   3) Handling Precautions 4
   4) Maintenance 5
   5) Precautions for the Battery Pack 6

2. Package Contents 8

3. Nomenclature 9
   Measuring Unit (Patient side) 9
   Measuring Unit (Operator side) 10
   Measuring Unit Switch Panel 11
   Station 12
   Station rear view 12
   Printer 13
   Printer bottom view 13
   Retinomax K-plus System Configuration 14

4. Preparation 15

5. Charging the Battery Pack 18
   1) Before charging the battery pack for the first time 18
   2) Automatic charging of measuring unit battery pack 19
   3) Automatic charging of the printer battery pack 21
   4) Renewing the battery pack 23
   5) Forced charging 24
   6) Charging the optional spare battery pack 25
   7) Helpful Tips 25

6. Measurement Method 26
   1) Measurement 26
      (1) Before measurement 27
      (2) Measurement mode 27
      (3) Measurement procedure 27
      Automatic Fogging System 31
      Power Saving 31
      The IOL eyes measurement 31
      CYL measurement range 31

2) Helpful hints for successful measurement 32
When the right and left eyes are not correctly identified 32
Measurement with bed-ridden patients (45°, 90° or 135°) 33
When the measurement is not successfully done due to instability or quick movement of the patient's eyes (QUICK mode) 33
Using the Forehead Rest 34
Imperfect Image Prevention 34
When correct measured values are not obtained 35
Precautions during the KER mode 36
3) Printout 37
Setting the Printer DIP Switch 39
Representative Values (for Refractive) 40
Consistency Values (for Refractive) 40
Battery operation of the Printer 41
4) Kerato-peripheral Measurement (PERI) 42
5) Retro mode (RETRO) 44
6) Measuring Hard Contact Lens Base Curve 45

7. Initial Settings 46
1) Initial Setting (SETUP) Screen 46
2) Initialization Setting Screen 47
3) Print Setting Screen 48
4) Clock Screen 49
5) Patient Number Setting Screen 50
6) Message Input Screen 51
7) OUTPUT Setting Screen 52

8. Maintenance 53
1) Replacing Paper Roll 53
2) Fuses Replacement 55
3) Cleaning the Forehead Rest 55
4) Cleaning the Measuring Window 56
5) Model Eye 56

9. Connection with External Device 57

10. Using AC-adapter P-400 (option) 57

11. Troubleshooting 58

12. Specifications 61

13. Index 63

1. Precautions for Operations

The product and manual you bought show the precautions you should follow to prevent injuries to you or other person and damages to your property and use this equipment safely.
Items below show the meanings of the signs used in this manual. Understand fully these meanings before you read this manual.

Warning	This indication shows that a death or personal injury might occur if you disregard this indication and use the equipment improperly.
Caution	This indication shows that a personal injury or a damage only to a material might occur if you disregard this indication and use the equipment improperly.

	This sign shows a warning (including a caution). The contents of warning are drawn in a triangle (the figure on the left shows the warning against an electric shock).
	This sign shows a prohibited operation. The contents of prohibition are drawn in or near a circle (the figure on the left shows the prohibition against disassembly).

1) Safety Precautions

Caution

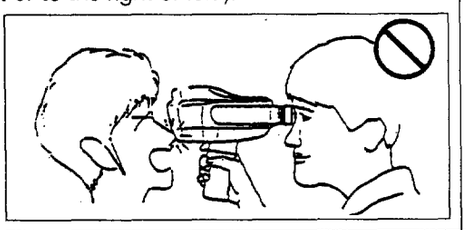
Never disassemble this instrument (the unit contains hazardous high-voltage parts which can cause serious injury).

Caution

Do not drop the measuring unit. Use the accompanying safety strap when handling the measuring unit. Do not drop on the unit. Do not move the unit only by pulling the strap.

Caution

Make sure that the measuring unit does not bump against the patient's face (when moving it toward the patient or to the right or left).



Caution

If water or a foreign matter should get into the equipment, turn off the power and remove the power plug from the outlet. Then call your local Nikon dealer. If you keep on using the equipment, a fire or electric shock might occur.

Caution

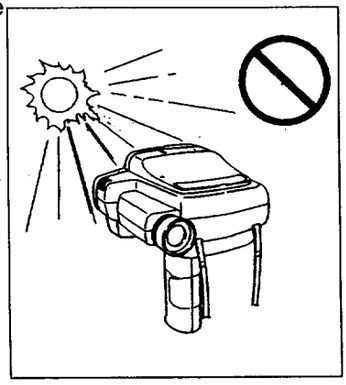
Do not place the equipment in a unstable location (i.e. shaky or slant location). Otherwise, the equipment might drop or come down to cause a personal injury.

Caution

Do not damage, break down, modify, forcibly bend, pull, twist, or band the power cable. You also must not place a heavy material on the equipment or heat the equipment. Otherwise, the cable might be broken down and a fire or electric shock might occur. If the power cable is damaged, replace it with a new one.

Caution If dust attaches on and around the metal edge of the power plug, wipe the dust off the plug. Otherwise, a fire might occur due to a drop in the power plug insulation performance.	**Caution** While looking into the view finder, you must pay much attention to the circumstances around you so as not to cause any risks. Nikon shall not be liable for incidental or consequential damages resulting from any other cases than the use of this equipment.

2) Environmental Requirements

Caution The best environment for proper operation is between approximately 10-40° C (50-104° F) room temperature, 700hPa ~ 1,060hPa barometic pressure, and 30 ~ 75% humidity.	**Caution** The equipment is not waterproof and therefore must not be placed in an environment where water (or any liquid) may come in contact with the unit.
Caution When moisture forms on the instrument, do not use it until the moisture evaporates.	**Caution** The unit is virtually dustproof, but if possible keep it away from dust.
Caution Place the station and printer in an area that has adequate ventilation. Do not put a thick cloth or paper under the station or printer, because they radiate heat when charging. Do not obstruct the ventilation hole. Otherwise, heat remains inside the equipment and a fire or malfunction might occur.	**Caution** The best place for operation is in a dimly lit room. The measuring window should not be subjected to bright, light, because the measuring accuracy may be compromised. Do not take light from the circumference of the measuring window. Otherwise, the measurement precision might drop. 

3) Handling Precautions

Caution Do not hold the measuring unit by any part other than the grip of the unit (such as the view finder or forehead rest).	**Caution** Handle the measuring unit with care.
Caution Do not unnecessarily swing the measuring unit.	**Caution** Do not place the measuring unit or printer near any magnetic object.

Caution

Do not touch the contact points of the connectors or the charging terminals with your hand or any metal object. If the contact points are stained, or become tarnished turn the power switch off and then wipe them with a dry clear soft cloth.

Caution

Hold the plug when disconnecting the power cable or the optional communication cable from the outlet or connector to not break or damage the cable. When you remove a plug or connector, pull it carefully. If you remove them by pulling the cables, the cables might be damaged and could cause a fire or electric shock.

Caution

Use only the Nikon-designated battery pack and optional AC adapter. Do not connect and disconnect the power plug when your hands are wet.

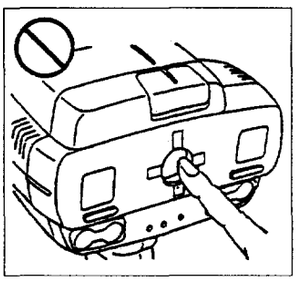
Caution

Never short-circuit the contact points and the terminals of the station. If you short-circuit the unit it will blow the fuses for the unit and the printer.

4) Maintenance

Caution

The measuring unit is a precision optical instrument. If the measuring window glass is smudged with grease from the patient's nose, finger prints or dust, accurate measured values will not be obtainable. Kerato-center measuring window and the cornea peripheral measuring window are smudged with grease or dust, accurate measured values will not be obtainable. Keep the windows glass clean. When you clean the glass, be careful not to scratch or break it (see "4) Cleaning the measuring window" in page 56).



Caution

After operation, turn the power switch off and cover the instrument with the vinyl cover that was provided. When you store or do not use the equipment, remove the power plug from the outlet for safety.

Caution

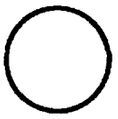
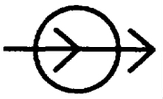
Keep the room temperature within the range of –25°C ~ +45°C when the unit is kept and is transported.

5) Precautions for the Battery Pack

Caution Use only the DURACELL nickel-metal hydride battery DR10 (manufactured by Duracell). Nikon will not assure proper operation if you use any other type of battery pack. Read the manual provided with battery pack before use.	**Caution** Never disassemble the battery pack. When you maintain or do not use the equipment, remove the power plug from the outlet for safety.
Caution Never short-circuit the battery pack terminal, because you may get burned by the generated heat. Take precaution so that any metal (such as a coin or paper clip) does not touch the terminals.	**Caution** Charge the battery pack only with the specified printer or station (if the battery pack is installed in the measuring unit).
Caution Do not expose the battery pack to any source of excessive heat or flames, because it may explode, leak or cause a fire.	**Caution** Be careful not to jar or drop the battery pack.
Caution Do not leave the battery pack in a hot place (such as inside a car).	**Caution** If the metal terminals of the battery pack are tarnished, wipe it with a dry and soft cloth.
Caution When not using the measuring unit or printer, remove the battery.	

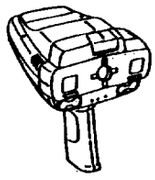
Rechargeable battery of Retinomax K-Plus and Retinomax printer is Nickel-metal hydride battery.
Retinomax K-Plus measuring unit install Lithium battery for clock function. Please process the battery according to the rule of the local government when you abandon those batteries.

The meanings of the signs indicated on the cover and the name plate of the Retinomax K-Plus are as follows:

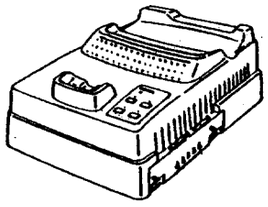
	A.C.		OFF
	FUSE		ON
	CAUTION		INPUT, OUTPUT
	B Type Instrument		

2. Package Contents

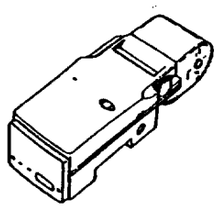
When opening the package, make sure that all the following items are included.



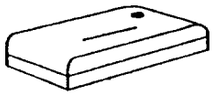
Measuring unit (1)



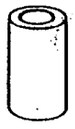
Station (1)



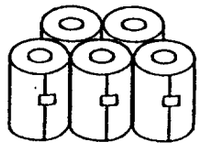
Printer (1)



Battery pack (1)



Model eye (1)



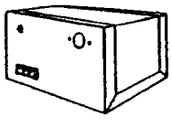
Print paper roll (5)

Strap (1)

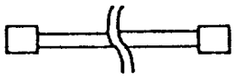
Blower (1)

Contact lens holder
Power cable set (1)
Fuse (2)
Vinyl cover (1)
Instructions (1)

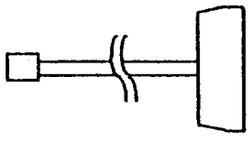
Options



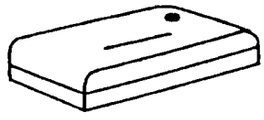
AC adapter P-400



DC cord



Communication cable



Battery pack

Carrying case

3. Nomenclature

Measuring unit (Patient side)

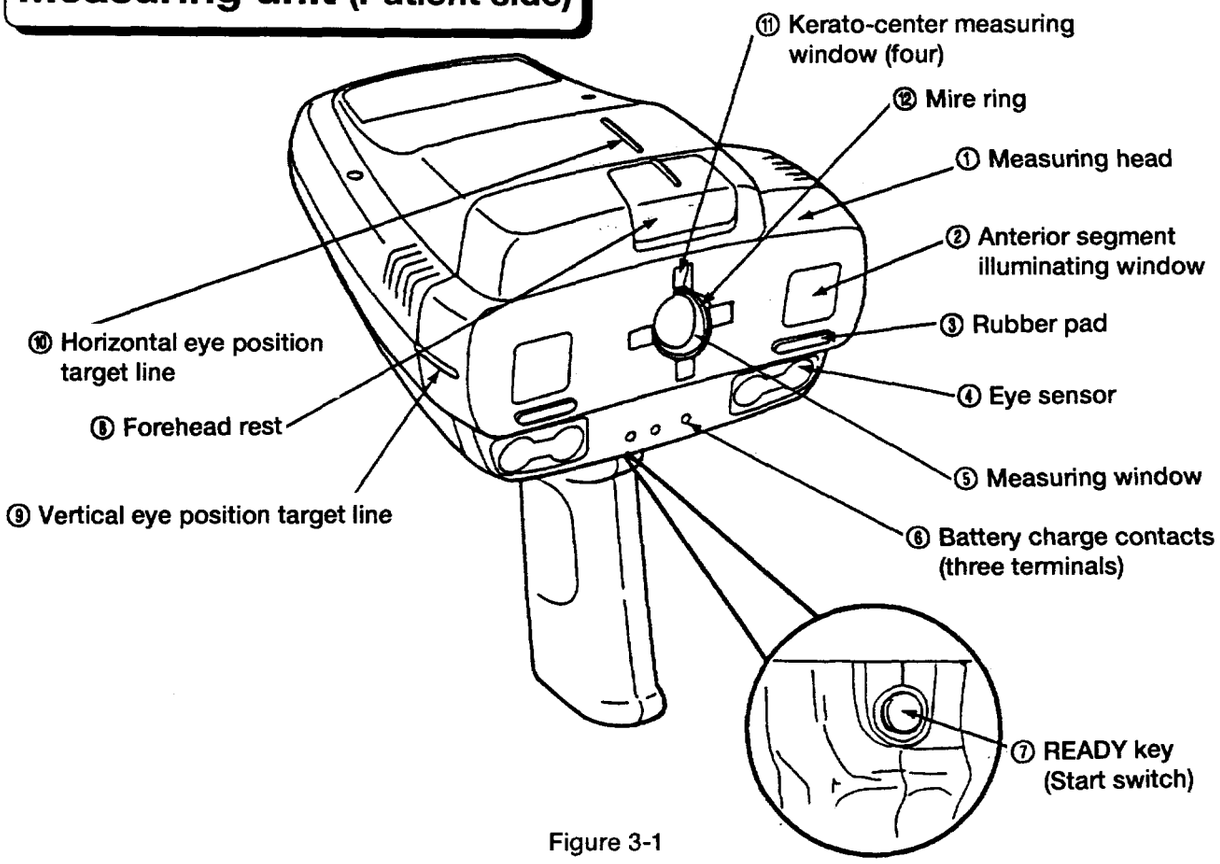

⑪ Kerato-center measuring window (four)
⑫ Mire ring
① Measuring head
② Anterior segment illuminating window
③ Rubber pad
④ Eye sensor
⑤ Measuring window
⑥ Battery charge contacts (three terminals)
⑦ READY key (Start switch)
⑧ Forehead rest
⑨ Vertical eye position target line
⑩ Horizontal eye position target line

Figure 3-1

① **Measuring head** .....Contains the measuring mechanism.

② **Anterior segment illuminating window and cornea peripheral measuring window** .....Lights the anterior segment.

③ **Rubber pad** .....Shock absorbing rubber, this cushion is used when placing the measuring unit on the station.

④ **Eye sensor**.....Automatically identifies the patient's right and left eyes by using ultrasonic waves.

⑤ **Measuring window**.....The patient looks at the target (see Figure 6-4 in page 27) through this window.

⑥ **Battery charge contacts (three terminals)** .....Connected with the charging contact of the station (see page 12) to charge the battery pack (see page 20).

⑦ **READY key (Start switch)** .....Starts and ends measurement (see page 27).

⑧ **Forehead rest**.....Gently press against the patient's forehead to stabilize the measuring unit (see page 34).

⑨ **Vertical eye position target line**.....Align with the patient's eye to determine the correct height (see page 28).

⑩ **Horizontal eye position target line**. .Align with the patient's eye to determine the correct horizontal position (see page 28).

⑪ **Kerato-center measuring window**...A window to measure the cornea-center.

⑫ **Mire ring** .....A target for alignment. Observes the degree of cornea distortion.

Measuring unit (Operator side)

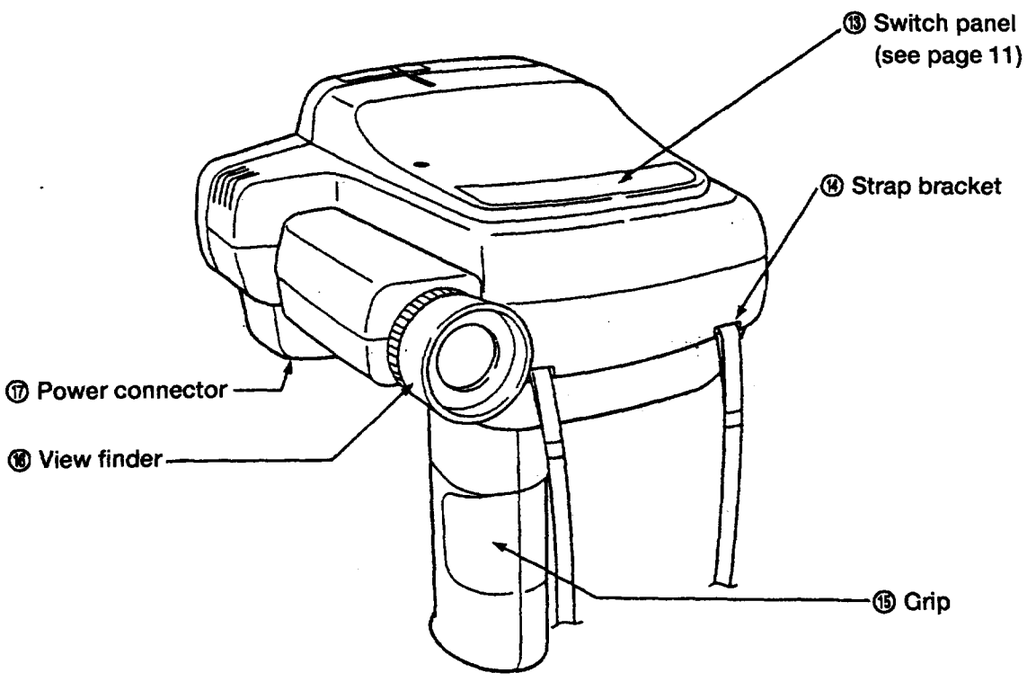


Figure 3-2

⑬ **Switch panel** .....See "Measuring Unit Switch Panel" in page 11 and "Measurement Method" in page 26.
⑭ **Strap bracket** .....Attach the strap through this bracket (see page 15).
⑮ **Grip**.....Hold this grip with your hand when using the measuring unit.
⑯ **View finder** .....Look at the patient's eye through this view finder for proper alignment.
⑰ **Power connector** .....Connect an optional AC adapter with this connector to supply power to the measuring unit from a wall outlet. (see page 57)

Measuring Unit Switch Panel

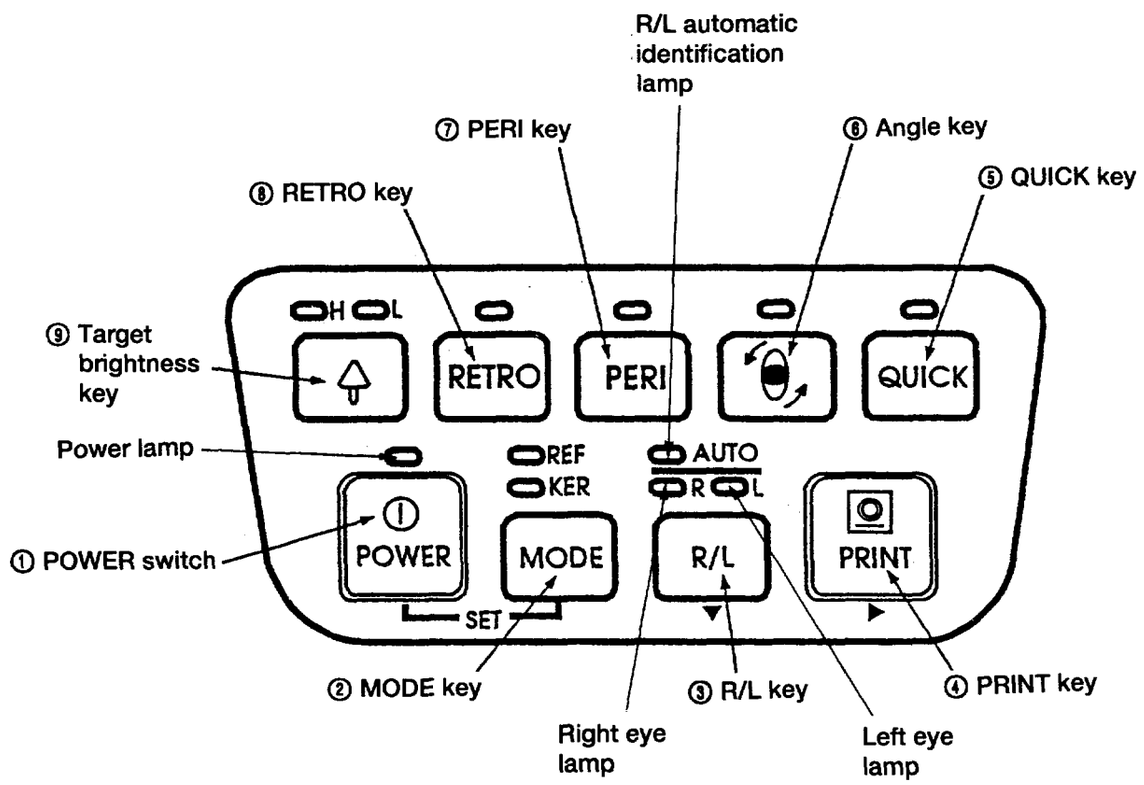


Figure 3-3

① **POWER switch** .....Sets the power ON and OFF for the measuring unit.
② **MODE key**.....Sets the mode between REF (Refractive), KER (Kerato), and REF/KER (Refractive/Kerato) measurement.
③ **R/L key**.....Sets the right and left eyes identification between the automatic and manual mode. In the manual mode, you select the patient's right and left eyes manually (see page 32).
④ **PRINT key**.....Sends the measurement data to the printer (see page 37).
⑤ **QUICK key** .....Allows you to enter Quick mode (see page 33).
⑥ **Angle key** .....Turns the measuring unit by 45°, 90° or 135°. Automatically compensates for the Ax (cylindrical axis) by 45°, 90° or 135° (see page 33).
⑦ **PERI key** .....Measures the cornea-peripheral.
⑧ **RETRO key** .....Observes inside the pupil.
⑨ **Target brightness key** .....Sets the brightness of the target between H (bright) and L (dark).

Station

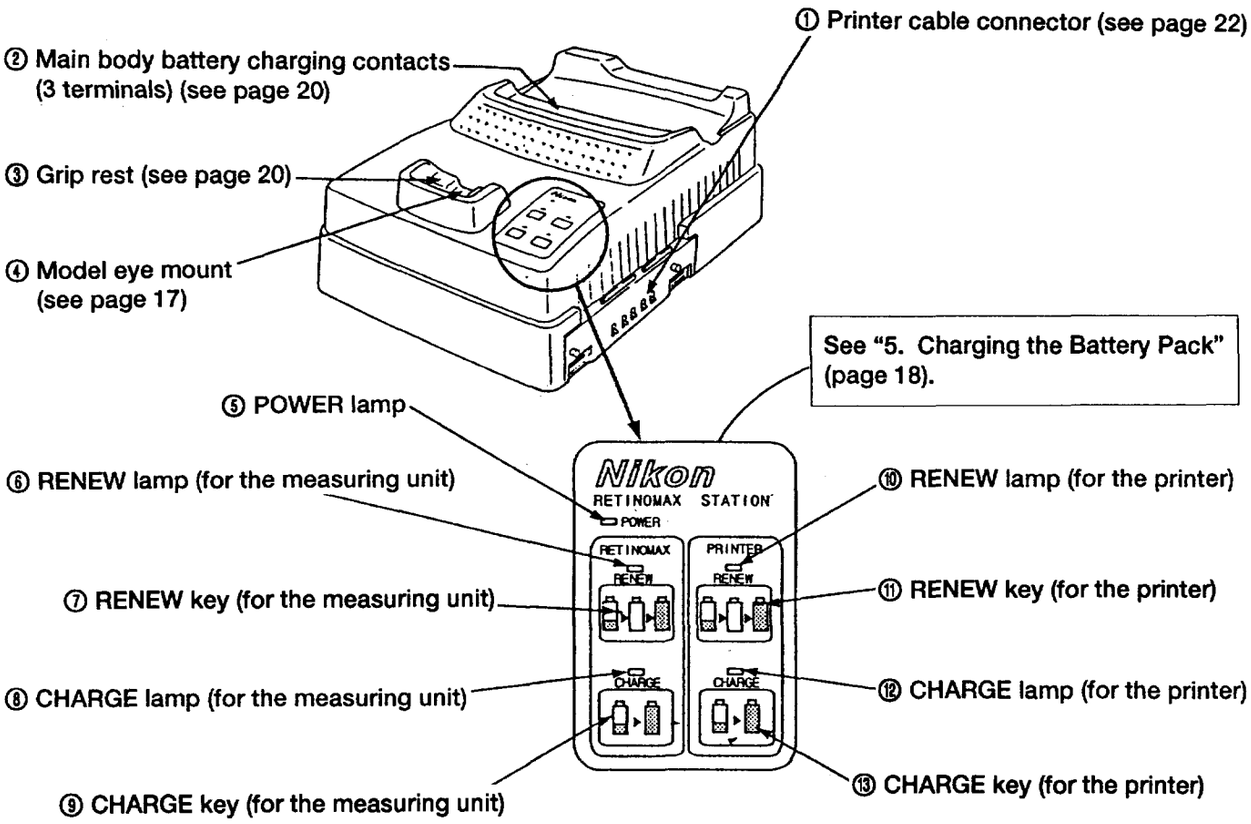

① Printer cable connector (see page 22)
② Main body battery charging contacts (3 terminals) (see page 20)
③ Grip rest (see page 20)
④ Model eye mount (see page 17)
See "5. Charging the Battery Pack" (page 18).
⑤ POWER lamp
⑥ RENEW lamp (for the measuring unit)
⑦ RENEW key (for the measuring unit)
⑧ CHARGE lamp (for the measuring unit)
⑨ CHARGE key (for the measuring unit)
⑩ RENEW lamp (for the printer)
⑪ RENEW key (for the printer)
⑫ CHARGE lamp (for the printer)
⑬ CHARGE key (for the printer)
Nikon
RETINOMAX STATION
POWER
RETINOMAX
PRINTER
RENEW
CHARGE

Figure 3-4

Station rear view

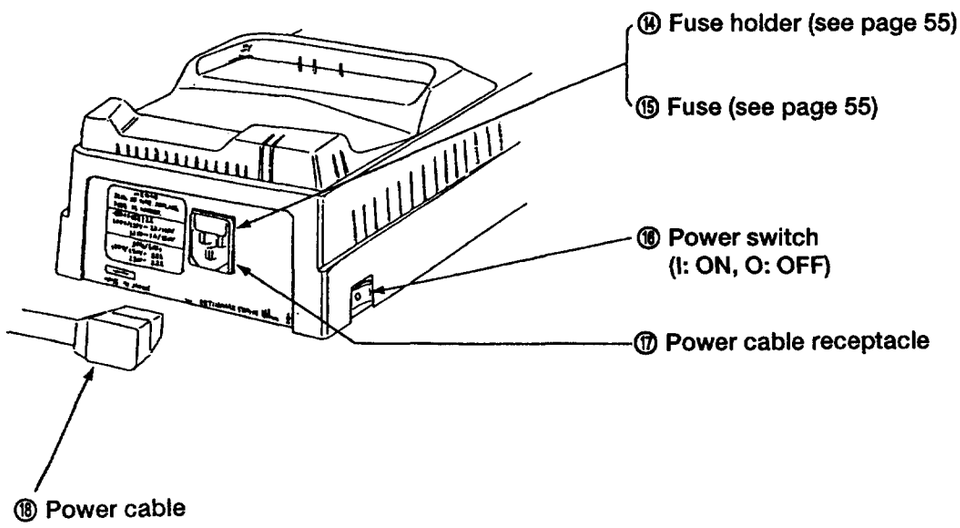


Figure 3-5

Printer

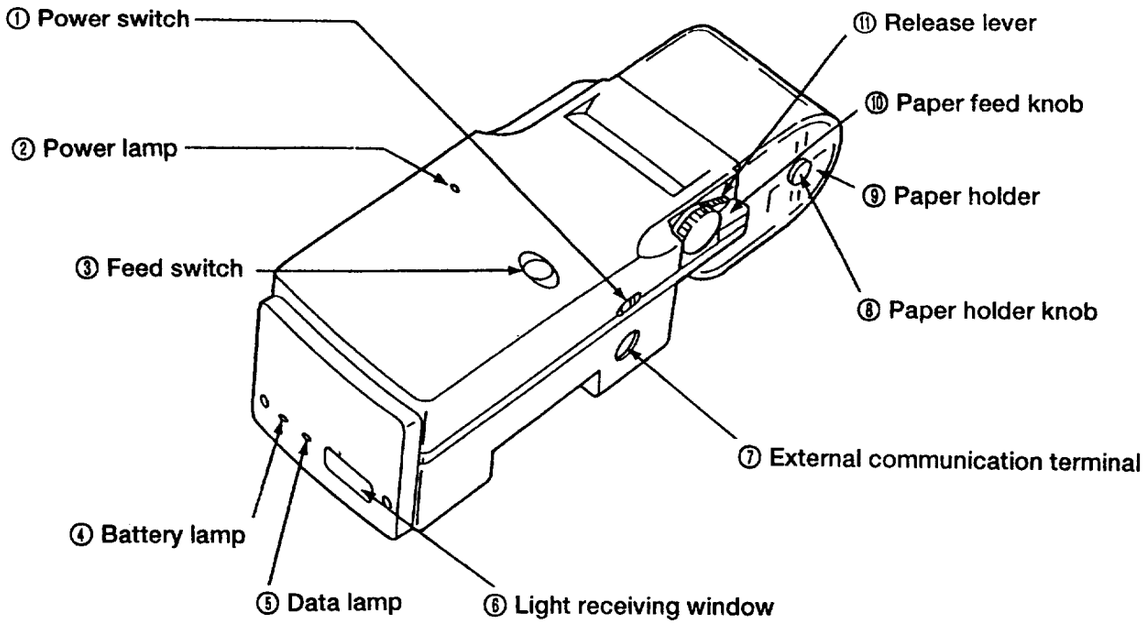


Figure 3-6

Printer bottom view

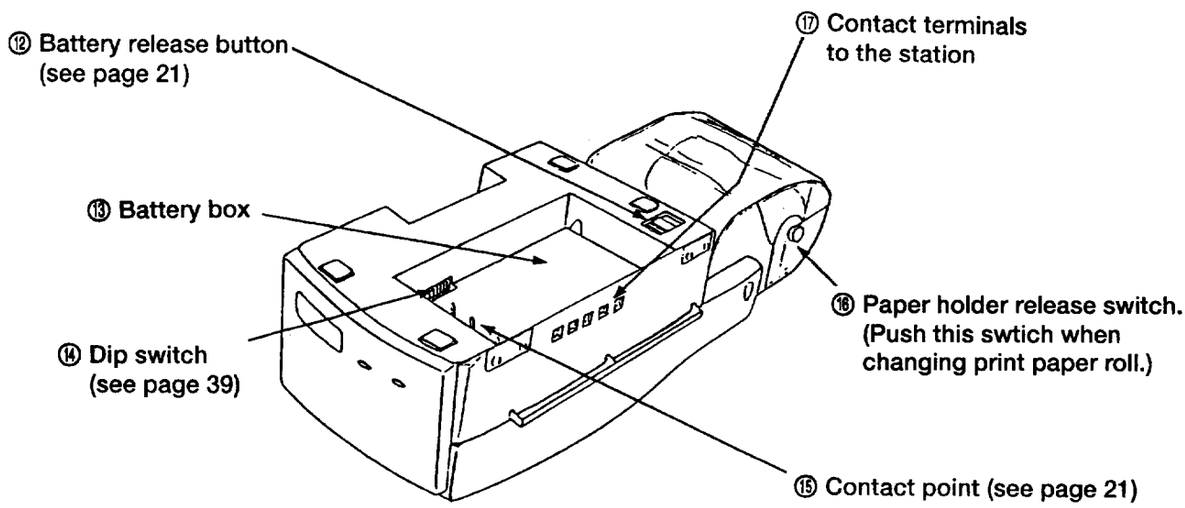

⑫ Battery release button (see page 21)
⑬ Battery box
⑭ Dip switch (see page 39)
⑮ Contact point (see page 21)
⑯ Paper holder release switch. (Push this swtich when changing print paper roll.)
⑰ Contact terminals to the station

Figure 3-7

Retinomax K-plus System Configuration

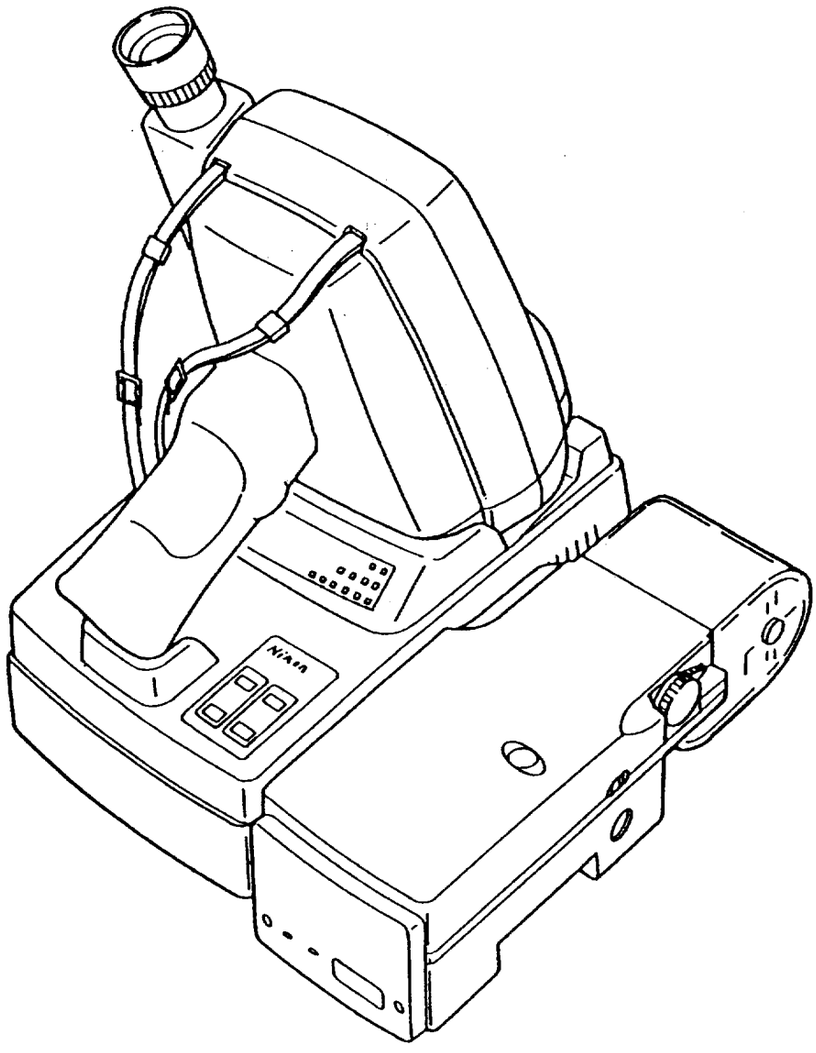


Figure 3-8

4. Preparation

(1) Attach the strap to the measuring unit.
(see Figure 4-1)

> ⚠ Caution
> Attach the strap firmly to protect it from coming off. If the strap is damaged, replace it with a new one.

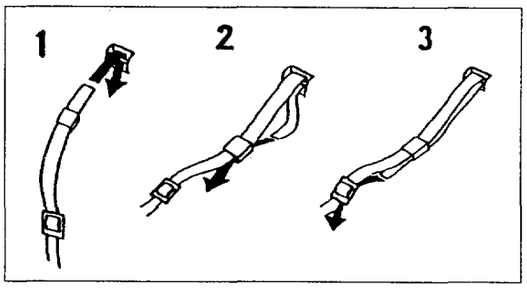


Figure 4-1

(2) Connect the power cable to the power cable socket located on the station.

(3) Make sure that the station power switch is set to OFF, and plug the power cable into a wall outlet.

(4) Turn the station power switch on.
The power lamp will illuminate.

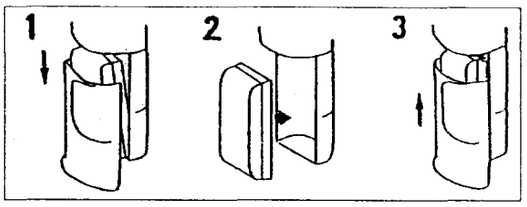


Figure 4-2

(5) Install the battery pack into the measuring unit.
→ See "5. Charging the Battery Pack" (Figures 5-1, 5-2 and 5-3 in page 19).

(6) Charge the battery by placing the measuring unit on the station. (It takes about 90 minutes to charge a fully discharged battery.)
→ See "5. Charging the Battery Pack"
- When received a new battery pack is fully discharged and therefore must be charged for 90 minutes before initial use.
- When a new battery pack is installed or after the unit has not been used for a long time, it will require the battery to be charged/discharged a few times in order to permit the battery to hold a proper charge for use.

When you charge your battery for the first time, you may get an indication of the charging being complete after just 10 to 15 minutes. This is normal and can happen with all rechargeable batteries when first charged.

↓

Press the CHARGE key or RENEW key for the unit. If the CHARGE lamp does not illuminate, press the CHARGE key again.

(7) Install the paper roll into the printer.
See "8. Maintenance" (page 53).

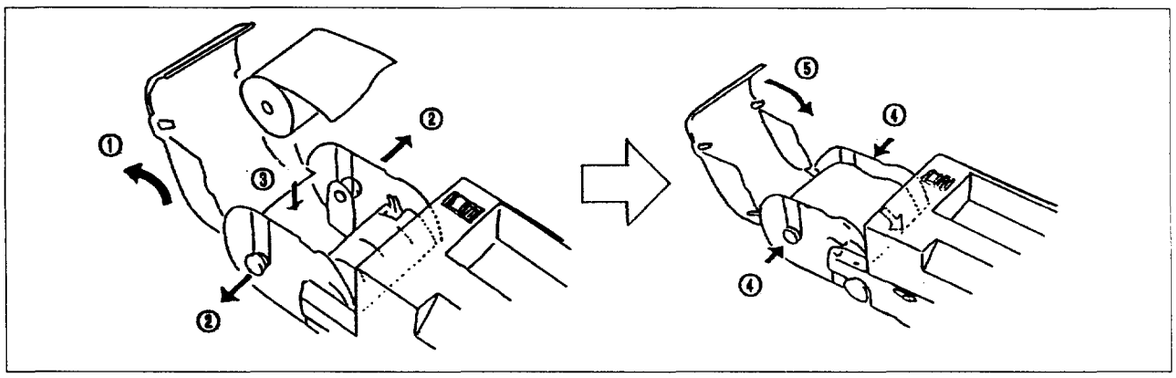


Figure 4-3

(8) Connect the printer with the station.
(see Figure 5-10 in page 22)

(9) Turn the printer power switch on.
Press the feed switch and feed the paper up to the appropriate position.
- The printer can be operated by using the battery pack. When you do not use the battery pack, connect the printer to the station. If the station power is turned off, the printer cannot be used.

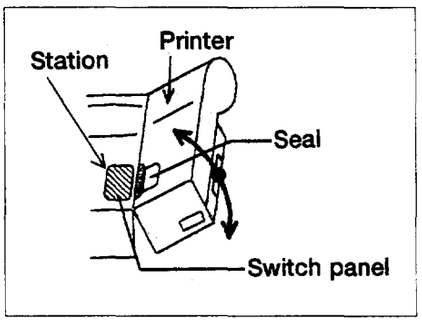


Figure 4-4

(10) Remove the measuring unit from the station, and turn the measuring unit on. (see page 54)

(11) Complete various settings.
→ See "7. Initial Settings " (page 46).

The initial settings are shown below.

	AC 120V area	AC 230V area
CYL MODE	C-	C-
VD	13.75	12.0
BUZZER	ON	ON

Initialization

QUICK	NORMAL	(Cancels QUICK when initializing)
RL SENSE	AUTO	(Sets as automatic for RL identification when initializing)
R/K MODE	R/K	(Sets as the REF/KER mode when initializing)
AX ROTATION	NORMAL	(Cancels the Ax compensation mode when Initializing)

Print setting

REF RPINT	ALL	(Prints out all the data measured in the REF mode)
KER PRINT	REF	(Prints out only the representative values measured in the KER mode)
MESSAGE	OFF	(Does not print out)
EYE PRINT	OFF	(Does not print out)

Clock setting

	AC 120V area	AC 230V area
DATE-FORM	MDY	DMY
TIME-FORM	12H	24H

Output setting

PRT RS OUT	OFF	(Does not send data from the printer RS232C)
PRT RS BAUD	1200	(Sends at 1200 bps of the printer RS232C)
UNIT NO.	1	(Address of the measuring unit)
RS232C OUT	OFF	(Sends no data from the measuring unit RS232C)
RS232C BAUD	1200	(Sends at 1200 bps from the measuring unit RS232C)

(12) Measure the model eye which was provided with the unit. Make sure that the model eye and measuring window are clean. If either are dirty, carefully, clean them referring to sections "4) Cleaning the measuring window" and "5) Model eye" (page 56) in "8. Maintenance".

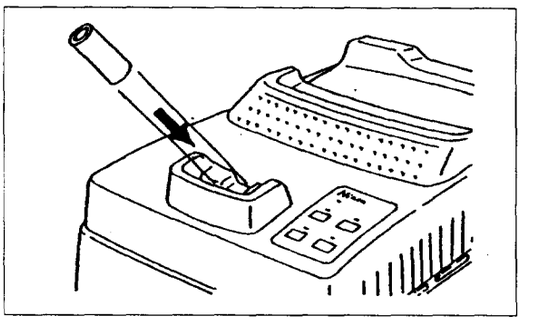


Figure 4-5

① Place the model eye on the model eye mount located on the station (see Figure 4-5).

② Refer to "6. Measurement Method" (page 26 for measuring the model eye.

> Note: Do not let the measuring window toward bright light when measuring. If the measuring window would be subjected to bright light, measuring accuracy may be deteriorated or measurement can not be done.

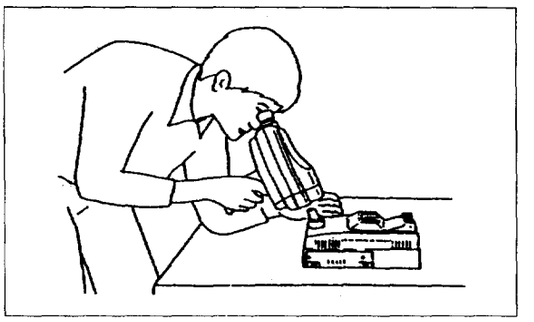


Figure 4-6

③ The measured values must be within the following range:

R1	8.00±0.03
R2	8.00±0.03
SPH	+4.0D ~ +5.5D

(CYL. Power should be read at 0 diopter. Spherical power measurement will vary from -0.25 ~ +0.25 diopters. This is a normal variance.)
If the measured value is out of the range, make sure that the measurement was performed correctly, if not, do the measurement again (see "6. Measurement Method", page 26).
When measuring the model eye, hold the measuring unit in a stable position (for example, place your elbow on the table) to accurately use the measuring unit.

(13) Clean the forehead rest by using ethyl alcohol or other appropriate cleaning liquid.

5. Charging the Battery Pack

1) Before charging the battery pack for the first time

(1) When using the battery for the first time

- Charge the battery before using it.
- The battery is not charged when you purchase it

(2) When you charge the battery for the first time or charge the battery unused for a month or more

The charge lamp goes off after about 10 to 15 minutes to show that the battery has been fully charged.
This occurs when you charge the battery pack for the first time.

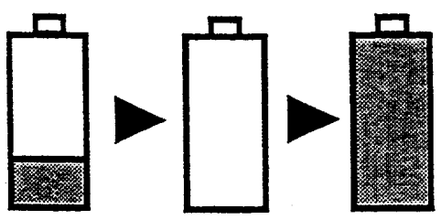
In this case, press the charge key to charge the battery again. (see page 24)
If the charge lamp does not go on when you press the charge key, press it again.
Renew the battery since the battery renewal enables you to fully charge the battery easily (see Page 23).
The battery pack gets warm when it is fully charged.
The grip also gets warm.

(3) Notes on the contacts

- If the contacts are contaminated, the battery charge cannot be performed properly due to the electrical contact fault.
- Be careful not to touch the station contacts (pins), measuring unit contacts (plates), and printer contacts (pins and plates).
- Also, be careful not to touch the battery pack contacts (plates).
- If you touch or contaminate a contact, wipe it with a dry cloth.

RENEW

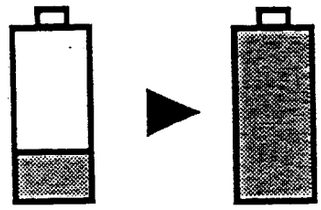
The battery pack then starts full-discharge cycle and then recharges fully.



see Page 23

CHARGE

The battery pack is forcedly charged.

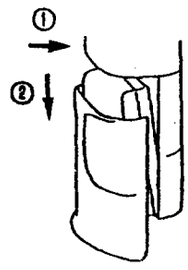


see Page 24

2) Automatic charging of the measuring unit battery pack

(1) Replacing the battery pack

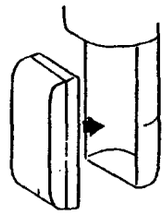
1



Open the battery pack cover located on the grip. Also, be careful not to touch the battery pack contacts (plates).

Figure 5-1

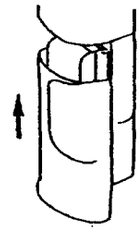
2



Replace the battery pack with a new one.

Figure 5-2

3



Replace the battery pack cover as shown in figure 5-3.

Figure 5-3

Note : When installing the battery, align the green seal on the battery pack with the figure in the grip, as shown in figure 5-4.

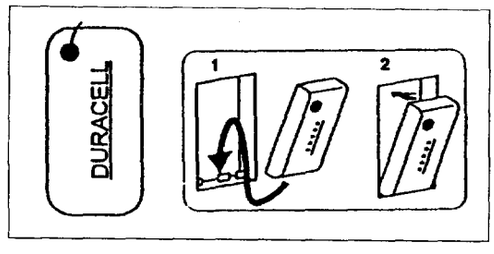
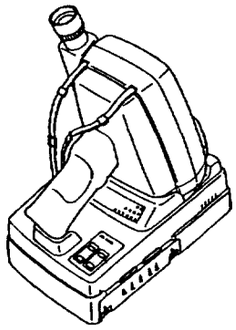


Figure 5-4

(2) Automatic charging

1 Turn the station power switch on.

2 Place the measuring unit on the station.



Note: Install the measuring unit completely in the station. Otherwise, the contact pins might not be connected. If the forehead rest is projected, the measuring unit cannot be installed completely in the station. Insert the forehead rest inside the measuring unit.
Make sure that the battery pack is installed inside the unit.

Figure 5-5

3 The station continuously monitors the voltage of the battery and when necessary automatically starts charging.
When the charging has started, the CHARGE lamp for the measuring unit will be illuminated. However, when the battery capacity is 50% or more , it will not be charged and the CHARGE lamp remains off to ensure longer life of the battery pack. When the battery capacity becomes less than 50%, it will be automatically charged to its maximum capacity (charging requires about 90 minutes).

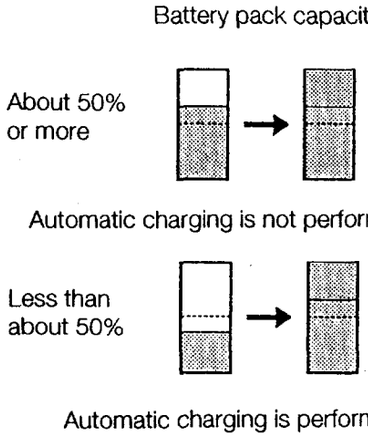

Battery pack capacity
About 50% or more
Automatic charging is not performed
Less than about 50%
Automatic charging is performed

Figure 5-6

4 When the charging is complete, the CHARGE lamp for the measuring unit goes off.

The charger will turn on automatically when the battery has less than half a charge. However if the battery is at more than 50% of its charge and you would like to "force" charge it further, you must press the charge button again.

* This value will change when the battery life has decreased its capacity according to the number of charge/discharge cycles.

Note: The battery is not always fully charged. To make it fully charged, use the CHARGE or RENEW key.

See "4) Renewing the battery pack" in page 23 and "5) Forced charging" in page 24.

3) Automatic charging of the printer battery pack

The printer can be operated with an optional battery pack (of the same type which is used for the measuring unit). It is located and installed in the printer battery box. The battery charge is performed in the printer battery box.

Remark: No battery pack is provided for the printer. You must purchase an additional battery pack for battery operation. The printer battery pack is the same type used for the measuring unit.

(1) Replacing the battery pack

1

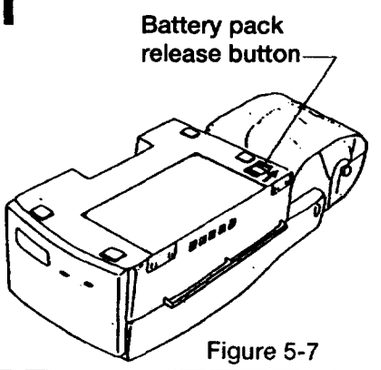


Figure 5-7

Turn the printer upside down. Then slide the battery pack release button upward to pop the battery outward for removal.

Slightly tilting the printer makes the battery pack easiery to be removed.

2

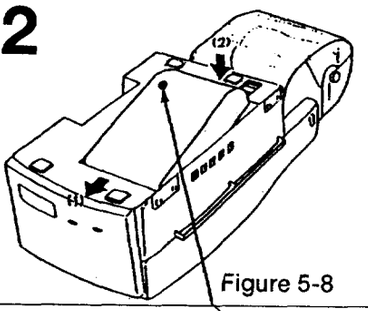


Figure 5-8

Remove the battery pack and install the new one as shown in figure 5-8. Make sure you correctly install the battery paying attention to the green seals, then first slide the side of the battery pack (1) into the battery box and then push down the side (2) until it locks in place.

Important!

When installing a battery pack, align the green seal on the battery pack as shown in the figure in the battery box.

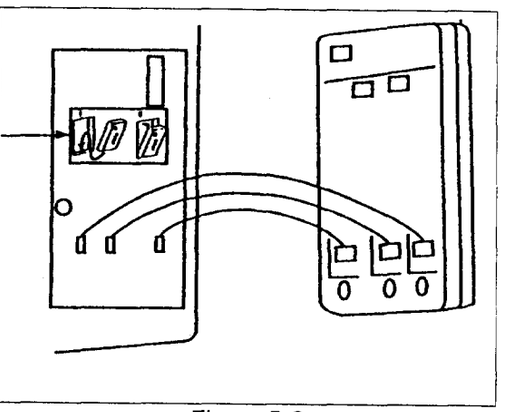


Figure 5-9

Note : Install the battery pack with the contact point positioned as shown in figure 5-9.

(2) Automatic charging

1 Turn the station power switch on.

2 Connect the printer with the station as shown in the figure 5-10.

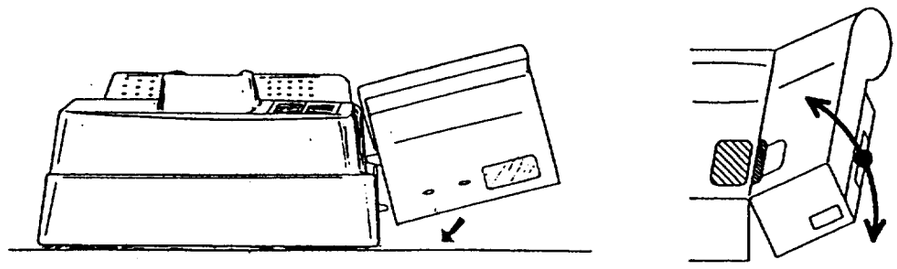
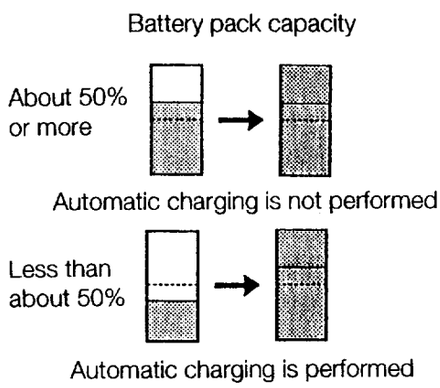


Figure 5-10

Match the right corner of the switch panel of the station to the left side of the label on the surface of the printer in order to connect the printer to the station easily.

3 The station automatically starts to charge the battery pack in the printer.


Battery pack capacity
About 50% or more
Automatic charging is not performed
Less than about 50%
Automatic charging is performed

When charging has started, the CHARGE lamp for the printer will be illuminated.
However, when the battery capacity is 50% or more, it will not be charged and the CHARGE lamp will remains off to ensure longer life of the battery pack. When the battery capacity becomes less than 50% , it will be charged to its maximum capacity automatically (charging requires about 90 minutes maximum).

Figure 5-11

4 When charging is complete, the CHARGE lamp for the printer goes off.

The charger will turn on automatically when the battery has less than half a charge. If the battery is at more than 50% of its charge and you would like to charge it further, you must press the charge button again.

* This value will change when the battery life has decreased its capacity according to the number of charge/discharge cycles.

Note 1: Place the printer and station in a stable location. Otherwise, the printer might not be connected properly to the station.

Note 2: The battery is not always fully charged. To make it fully charged, use the CHARGE or RENEW key.

See "4) Renewing the battery pack" in page 23 and "5) Forced charging" in page 24.

4) Renewing the battery pack

The batteries performance will be slightly affected from frequent charge / discharge cycles. (Which is called "memory-effect".)
A long life of the battery pack will be ensured by fully discharging and recharging it. This type of charging is called Renewing.
To renew the battery pack, perform the following procedure:

1

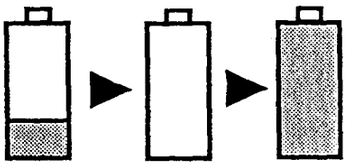
Press the RENEW key for a second or more.

The RENEW lamp is illuminated.

Figure 5-12

To renew the battery pack for the measuring unit, press the RENEW key for the measuring unit. For the printer, press the RENEW key for the printer.

2 The battery pack then starts a full-discharge cycle and then recharges fully.



Renewing a battery pack requires about four and a half hours maximum time, time will vary depending on the batteries capacity.

Figure 5-13

3 When the charging has been completed, the RENEW lamp will go off.

If you press the CHARGE key during renewing, the battery is forcedly charged.
If you do not want to charge the unit after placing it on the station, you must press and hold the RENEW key for more than one second. Or you must remove the unit and/or printer from the station entirely.
If the battery will not hold a charge recovered by renewing, it has run down and is no longer usable. We recommend you purchase a new battery pack from your local Nikon dealer.

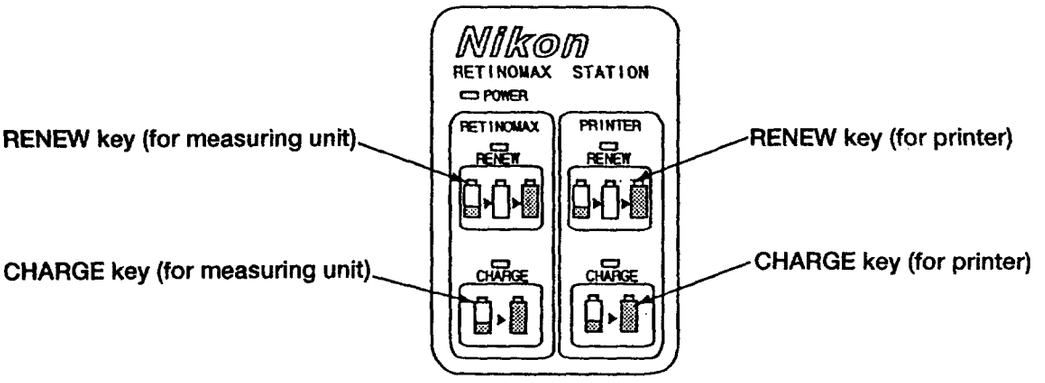


Figure 5-14

5) Forced charging

When forcedly charging the battery pack regardless of its current capacity perform the following procedure:

1 Press the CHARGE key.

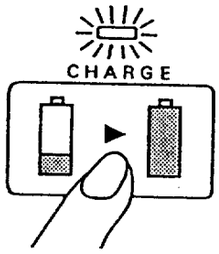


Figure 5-15

The CHARGE lamp is illuminated and the battery pack starts charging.

To charge the battery pack for the measuring unit, press the CHARGE key for the measuring unit. For the printer, press the CHARGE key for the printer.

2 The battery pack is forcedly charged.

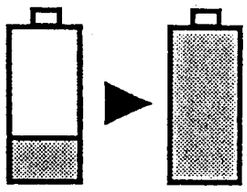


Figure 5-16

3 When charging is complete, the CHARGE lamp goes off.

If a battery pack is repeatedly charged, not only will its life be shortened but also the battery pack's memory feature reduces the capacity. We recommend that you renew the battery at one week intervals. Battery life will shorten due to the memory effect. The battery life will last longer if it is frequently renewed after use.

The charger automatically stops when the unit or printer is removed from the station.

♻BATTERY RECYCLING INFORMATION♻

Replacement batteries can be ordered from your Nikon ophthalmic dealer.

The DURACELL DR10 Rechargeable Battery used in your Retinomax Auto Refractor or K-Plus Auto Refractor/ Keratometer can be recycled. Call Duracell at the following toll-free number: 1-800-551-2355

Duracell will send you a postage pre-paid mailing label. Simply pack the batteries to be returned, affix the label and mail to Duracell.

PLEASE NOTE: Please return only rechargeable Duracell batteries.

6) Charging the optional spare battery pack

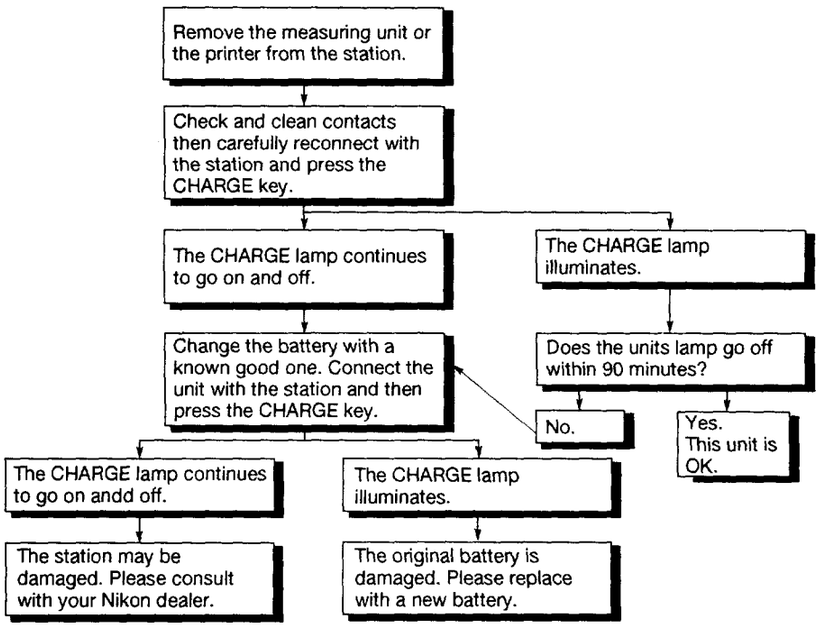
(1) Install the spare battery pack into the printer battery box following the procedure described in "(1) Replacing the battery pack", page 21.
(2) Charge the spare battery pack using the same procedure as charging the printer battery pack.
(3) After the charging is complete, remove the spare battery pack.

Important: Before using the battery pack, read the provided manual thoroughly.

⚠ Caution: Use only the DURACELL Nickel-metal hydride battery DR10.

7) Helpful Tips

(1) It is normal for the battery to become warm when renewing or charging.
(2) Once the batteries have been fully charged, you should not try to manually increase the batteries charge. If you do so this will result in decreased battery life. When the measuring unit or printer has been used for 30 minutes or has not been charged within the previous 3 hours, it is then safe to manually charge the batteries.
(3) If the printer or measuring unit has not been removed from the station for up to 2 hours after renewing or charging the batteries to their full capacity, you can not start the renew or charge process by pressing either button only once. This is a built-in safety feature to prevent over charging the batteries, and thus causing the batteries damage.
(4) If the CHARGE or RENEW lamp goes on and off, please follow the flow chart below.


Remove the measuring unit or the printer from the station.
Check and clean contacts then carefully reconnect with the station and press the CHARGE key.
The CHARGE lamp continues to go on and off.
The CHARGE lamp illuminates.
Change the battery with a known good one. Connect the unit with the station and then press the CHARGE key.
Does the units lamp go off within 90 minutes?
No.
Yes. This unit is OK.
The CHARGE lamp continues to go on andd off.
The CHARGE lamp illuminates.
The station may be damaged. Please consult with your Nikon dealer.
The original battery is damaged. Please replace with a new battery.

(5) If necessary, you can remove and use the measuring unit and/or printer prior to its being fully charged.

⚠ Caution

(6) Do not cover the measuring unit, printer, and station with any type of covers when charging the measuring unit battery or printer battery. Charging generates heat, which will make the measuring unit, printer, and station overheat if the covers are attached. This will cause damage to the batteries and shorten their life.

6. Measurement Method

1) Measurement

Follow the steps (2) through (10), as well as (11) through (13) if necessary, that are described in "4.Preparation" in page 15~17.

When you turn the Retinomax K-plus on, the opening screen appears (Figure 6-1). After a few seconds, the standby screen will appear (Figure 6-2) indicating that the K-plus has entered into the standby mode.

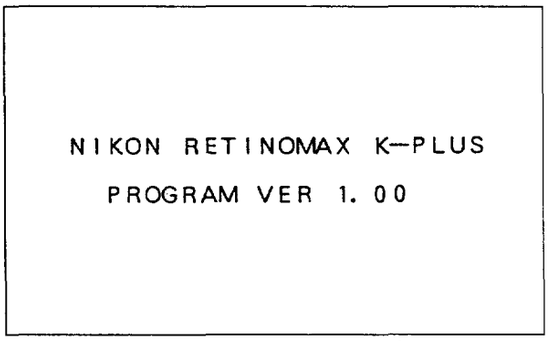


Figure 6-1 Sample Opening Screen

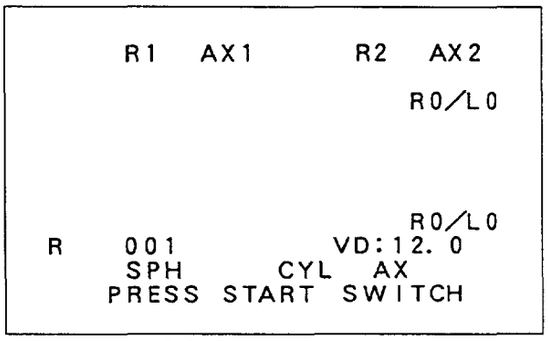
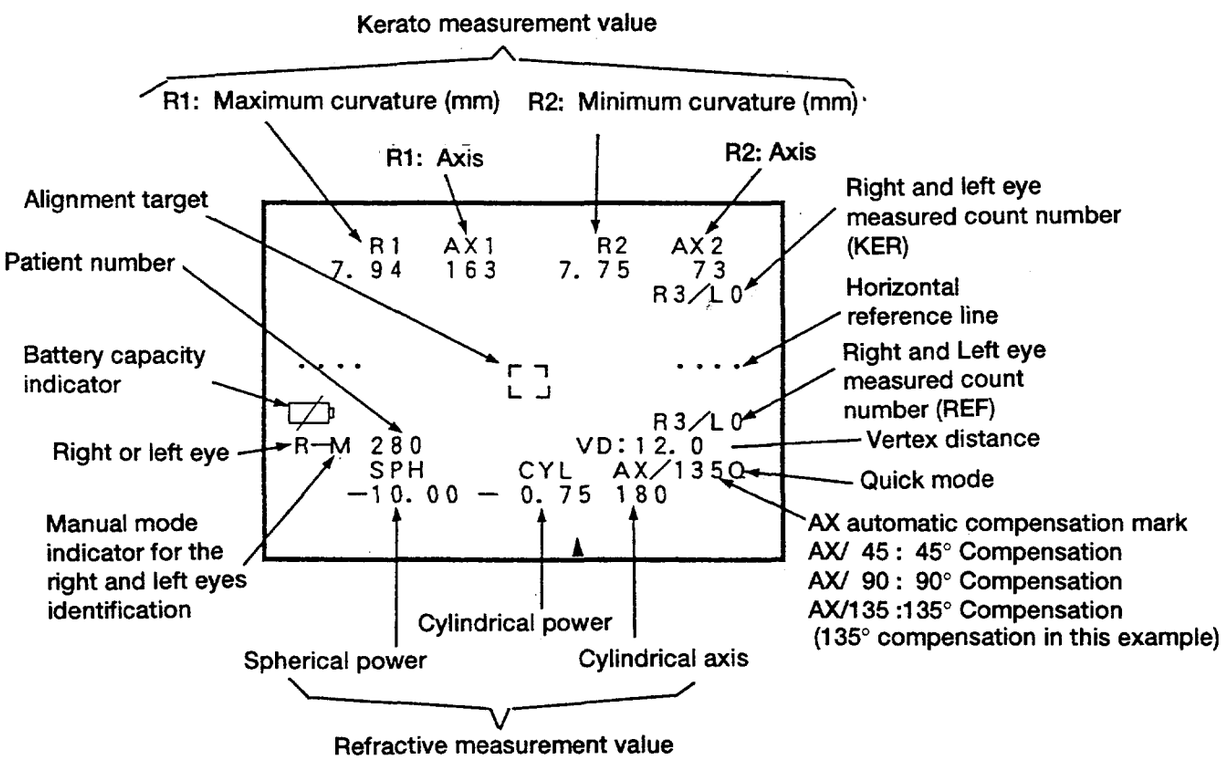


Figure 6-2 Sample Standby Screen

Measurement Screen



(1) Before measurement

① Most patients will be a little nervous, so try to relax them by explaining the measurement process in detail.

② Briefly explain the unit's operation and purpose to the patient:

- "This machine gives the doctor a starting point for the correct spectacle lens power for your eyes."
- "You will see a green field with a Christmas tree in the center. Please look at the tree with your eye in a relaxed manner."
- "Try to keep your eye open as long as possible."

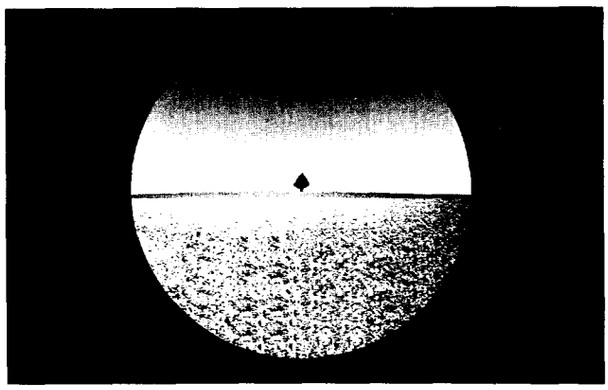


Figure 6-4 Target Screen by the Patient

Note : During measurement with 90° rotation, the patient will see the picture rotated by 90° respectively. During a measurement with 45° or 135° rotation, the patient will see the picture inclined.

(2) Measurement mode

Press the MODE switch to select either Refractive, Kerato, or Refractive/Kerato mode. The following is the explanation for the measurement in the Refractive/Kerato mode. (The operations for the Refractive and Kerato modes are the same.)

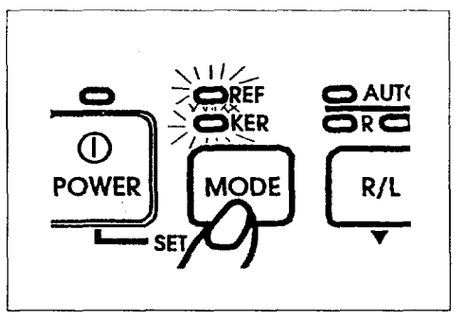


Figure 6-5

(3) Measurement procedure

① Show the patient where to sit. Ask the patient to rest both the hands on their lap to relax them.

② Press the Ready key on the measuring unit to enter the measurement mode (see Figure 6-6). In the measurement mode, when the alignment has been completed, the K-plus will automatically start measurement. Measurement cycles are taken in the measurement mode continuously.
Pressing the Ready key temporarily again halts the measurement mode, and pressing the Ready key once again returns the unit to the measurement mode for continued operation.

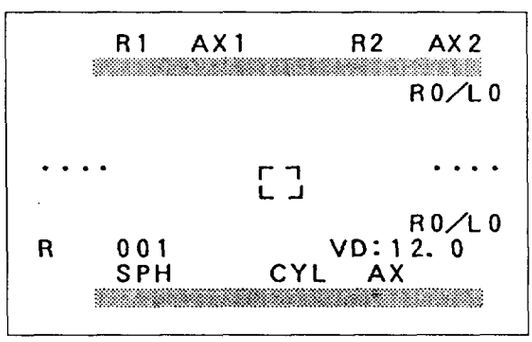


Figure 6-6 Sample Screen During Measurement

Note : Do not hold down the Ready key.

③ Rough alignment of the patient's eye (see Figure 6-7).

- Vertical: Align the patient's eye parallel with the target line located on the side of the measuring unit.
- Horizontal: Align the patient's eye parallel with the target line located on the top of the measuring unit.
- Working distance: Touch the forcehead rest on the patient's forehead. See the center dot is focused. If not focused push the forehead rest slowly. The working distance is about 40mm. Placing your other hand as shown in Figure 6-8 on the patient's head will stabilize the measurement procedure.

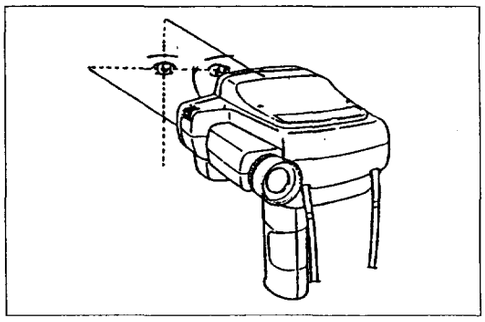


Figure 6-7

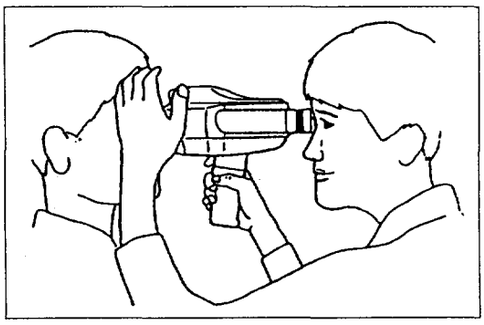


Figure 6-8

⚠ Caution	It might be difficult to identify an eye to be tested and the measuring unit might reach a patient's face if you search for the eye by looking into the view finder. Be sure to roughly fit the measuring unit position to the patient's eye position before looking into the view finder.

You can position the equipment in the front and rear directions more easily by placing your thumb at the groove on the cover (see Figure 6-8).
You can focus the equipment on an eye more easily by setting the forehead rest to touch around the patient's eyebrow before looking into the view finder (see "Using the Forehead Rest" in page 34).
When you fit the measuring unit to a patient's eye, be careful that the horizontal and vertical lines of the measuring unit are not slanted and that the eyelash does not cover the eye.

④ In the measurement mode, with the patient's eye roughly aligned, look through the view finder. When you see the patient's eye on the screen, position the pupil image towards the center (see Figure 6-9).
Then, move the measuring unit back and forth until the Mire ring image can be seen as sharp as possible.
When bringing the measuring unit close to the patient's eye, it will automatically identify the right and left eyes.
The eye being measured, whether right or left, will be indicated in the screen as shown in the figure on the right. (Unless measuring at a different angle 45°, 90°, etc.)
In the automatic eye identification mode, the buzzer will beep when an eye to be examined changes to the other during measurement. Use this mode to check which eye you are measuring.
However, the equipment might beep continuously when the sensor is placed between the right and left eyes because the eye identification is unstable.

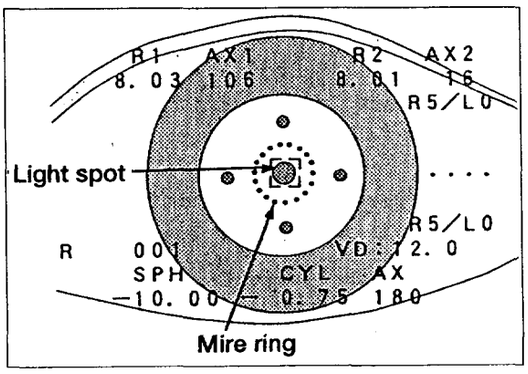


Figure 6-9

Note: The buzzer in the automatic eye identification mode beeps even if you set the BUZZER option to OFF in the initial setting (SETUP).

⑤ When the alignment process is complete, the measurement is automatically started.
Every time a measurement cycle is done, a beep sounds. (During the KER mode, the buzzer beeps for a short time and during the REF mode, the buzzer beeps for a long time.)
During measurement, four points illuminate in the KER mode and the central point illuminates in the REF mode. For the REF/KER mode, these illuminations are repeated. In the measurement mode, the automatic fogging system, in which the target is slightly blurred, operates.

(Refer to page 31)

⑥ Measured values are displayed directly on the screen (see Figure 6-10).

Measurement values

⑦ Take at least five measurements for each eye. If the eye movement of patient is unstable or the measurement values vary, take additional measurements.
The REF measurement values of the last eight measurement cycles for each eye will be used to calculate the measurement.
For the KER measurement, one Representative value will be used. (In Initial setting)

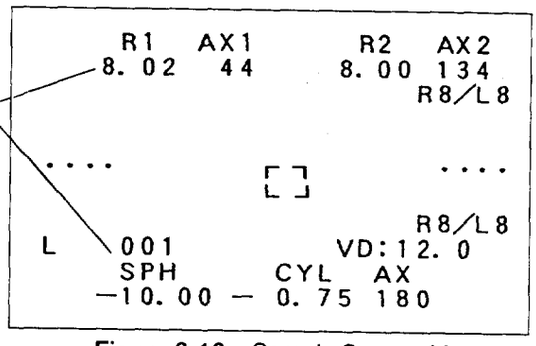


Figure 6-10 Sample Screen After Measurement

⑧ After measuring one of the patient's eyes, measure the other in the same manner.

⑨ Aim the front of the measuring unit toward the printer and press the PRINT key (see page 37).

Representative values

After the data is transmitted to the printer, representative values are displayed in the view finder as shown in figure 6-11.

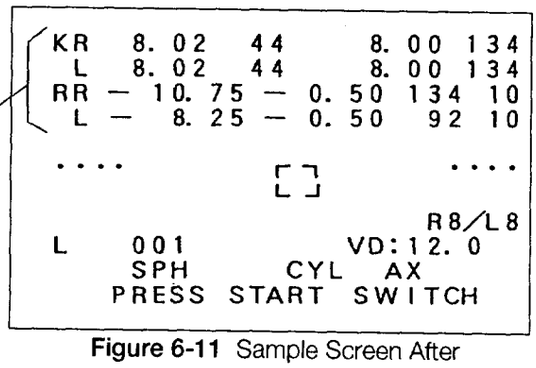


Figure 6-11 Sample Screen After Printout

Note: Pressing the PRINT key also increments the patient number by one.

To continue the measurement process, repeat the procedures as described above.
To end the measurement process, do the following steps.

⑩ After the forehead rest is used, return it to its original position.

⑪ Return the measuring unit to its original position on the station.

The screens for the REF and KER modes are as follows:

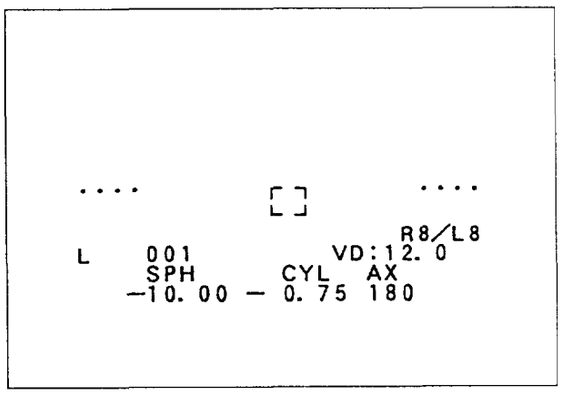
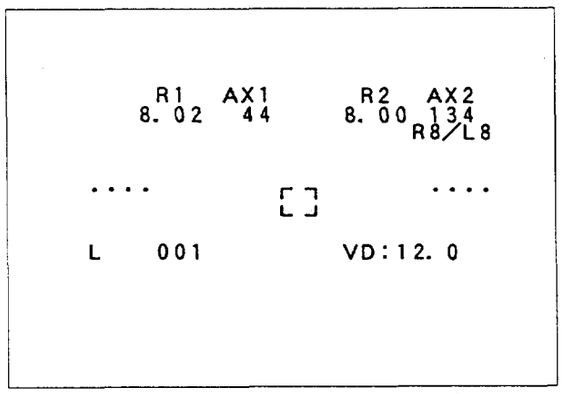


Figure 6-12 REF. Mode Measurement Screen



Figuer 6-13 KER. Mode Measurement Screen

Automatic Fogging System

The purpose of the Automatic Fogging System is to align the patient's eye correctly and then minimize the patient's eye accommodation. Once the patient's eye is aligned with the measuring unit, the fogging is then automatically made .

The target slightly blurs.

↓

When the alignment for the measurement is complete, the target will blur further (enters the fogging state).

↓

The instrument will beep each time it performs the measurement process. ◄
When it stops beeping, one measurement cycle has been completed.

↓

The patient will now see a dim target.

↓

The next measurement cycle starts.

Measurement is repeated while remaining in the fogging state.

Power Saving

When no key has been pressed for 3 minutes or more, the measuring unit is automatically turned OFF. To restart the measurement operation, press the POWER switch.

The IOL eyes measurement

The measuring unit will automatically measure IOL eyes (intraocular lens-contained eyes) in the same process as normal eyes without any special switch setting. IOL eyes should be measured as many times as possible (at least 8 cycles), because the measured values may vary in a wider range when compared to normal eyes.

CYL measurement range

The astigmatism measurement range is between –8.0 and +8.0. However, values ranging from -12.0 to -8.0 and from +8.0 to +12.0 are also displayed as references.

When you display an cylindrical power in this range, the string "C-OVER" is displayed under the cylindrical power. However, when you print the cylindrical power, only the cylindrical power is printed and "C-OVER" is not printed.

2) Helpful hints for successful measurement

When the right and left eyes are not correctly identified

- You must observe the following suggestions to operate the automatic eye identification function properly:
  - Do not touch the eye identification sensor when you insert your hand in between a patient's forehead and the sensor.
  - Set the sensor in front of a patient's face as follows to take measurement. Be sure the unit is horizontal with the patient's eye and aligned axially. If not, an incorrect decision may occur.
    When you set the sensor properly, you can obtain stable measurement results.

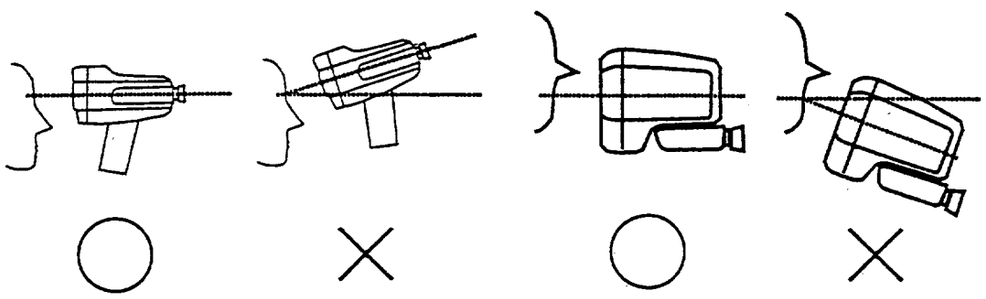


Figure 6-14

- If you cannot operate the automatic eye identification function properly (e.g. if the eye indication remains R when the measurement window is turned to the left eye) even by observing the above items, switch the eye identification mode to Manual Identification. In particular, the automatic eye identification function may not work properly in the following cases:
  - When a patient wears a mask over his/her mouth.
  - When a patient (especially a woman) has much hair over the cheek.
  - When a patient is a child whose face is very small.
  - * When you measure the patient's eyes from the vertex or temple, you must switch to the right and left eyes identification mode to manual.

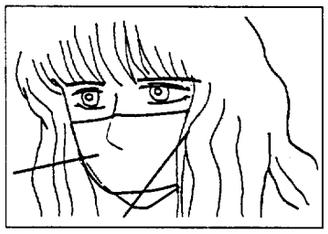


Figure 6-15

- To switch the right and left eyes identification mode from automatic to manual:
  Press the R/L key on the measuring unit switch panel.
  → The right eye measurement mode is entered and the right eye lamp (R) will illuminate.
  → Pressing the R/L key a second time switches the instrument to the left eye measurement mode and the left eye lamp (L) will illuminate. Subsequently, whenever you press the R/L key, the measurement mode will alternate between right and left.

To return to the automatic right and left eyes identification mode, press the PRINT key.
(Excluding when setting RL SENSE is set MANUAL, in page 47.)

Note: After transmitting the measurement data into the printing station, and restarting the measurement cycle (by the READY key), the previous patient data will be erased.

To switch to the manual right and left eyes identification mode after pressing the PRINT key (measurement data will be printed out), simply press the R/L key again.

Measurement with bed-ridden patients (45°, 90° or 135°)

When measuring bed-ridden patients from the 45°, 90° or 135° direction, an Ax compensation is required.
Select the AXIS compensation offset according to the measuring direction as shown on the right.
The Ax (cylindrical axis) shifting is performed by pressing the Angle key on the measuring unit switch panel; the first time the key is pressed the unit performs an automatic 45° compensation, the second time the key is pressed the unit performs an automatic 90° compensation, the third time the key is pressed the unit performs an automatic 135° compensation, and the fourth time the key is pressed the unit cancels the automatic compensation mode.
During the Ax automatic compensation mode, the Ax switching lamp will illuminate and the R/L reading mode automatically switches from automatic to manual.

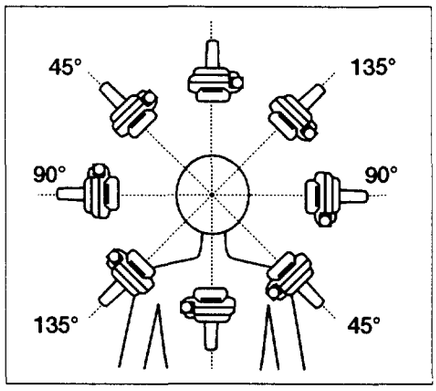


Figure 6-16

Pressing the PRINT key prints out the measurement data and then cancels the automatic compensation (excluding when AX ROTATION on the mode setting screen (p. 47) is set as HOLD) . An Ax automatic compensation mark will be shown on the printout (see page 38).

When the measurement is not successfully done due to instability or quick movement of the patient's eyes (QUICK mode)

- The Quick mode is useful, when a measurement can not be successfully done due to eye instability or quick movement of a child's eyes.
- Press the QUICK key on the measuring unit switch panel.
  The instrument enters the Quick mode and the measurement mode lamp will illuminate.
- The Quick mode increases the speed of measurement due to the automatic fogging being disabled, but may generate measured values that have less accuracy or vary over a wide range. During normal eye measurement you should not use the Quick mode.
- Printouts in the Quick mode contain the character "Q" indicating the unit was in the Quick mode. (see a sample printout in page 38)

Pressing the QUICK key again time cancels the Quick mode. The Quick mode will also be canceled when the PRINT key is pressed.
(excluding when QUICK on the mode setting screen is set as HOLD)

Using the Forehead Rest

When the patient's eyes are not stable, or when you cannot hold the measuring unit steady, using the forehead rest will make the measurement easier.
When measuring the patient, such as children, who tends to shake head, do not use forehead rest so as not to hurt the patient's face.

① Push the middle of the forehead rest to enable the forehead rest.
② Gently place the forehead rest onto the patient's forehead and then adjust the measurement distance by slowly pushing on the measuring unit.
③ If the forehead rest is not needed, return it to its original position.
④ When you install the measuring unit in the station, be sure to insert the forehead rest completely in the measuring unit before the installation.

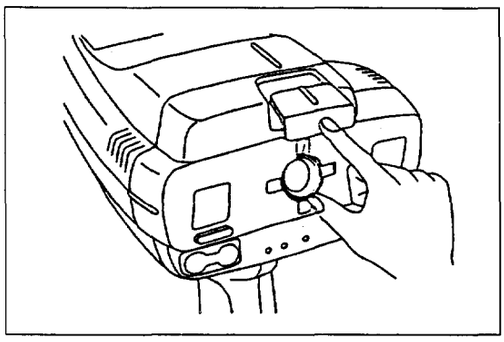


Figure 6-17

Imperfect Image Prevention

In the keratometry-refraction mode, measurement automatically shifts to the refraction, following keratometry. Simultaneously four LED mark will appear on the screen, with which the operator can determine whether or not the image is captured in full.

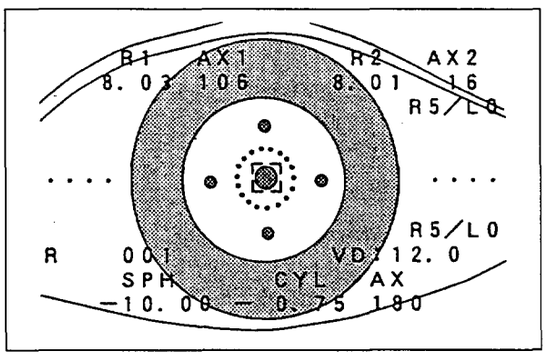


Figure 6-18

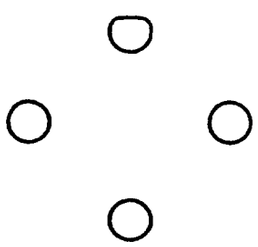


Figure 6-19

When correct measured values are not obtained

- If a patient has drooping eyelids, ask the patient to please open their eyes wider. And if necessary, have the patient or an assistant gently lift the eyelid with their finger.
- When you approach the patient to focus the patient's eye, you pay attention to look which a patient has drooping eyelashes.

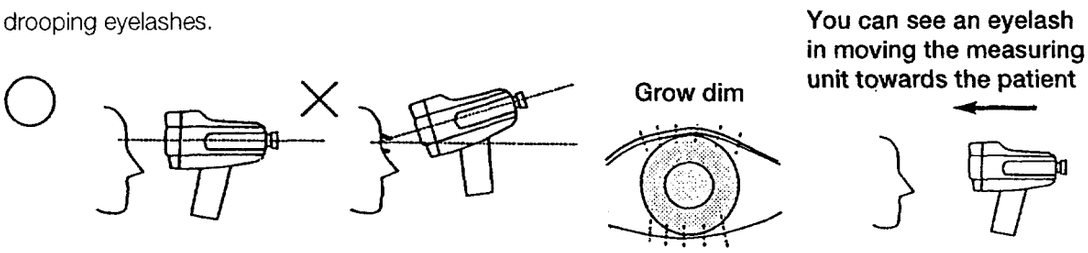


Figure 6-20

- Blinking during the measurement may cause the measurement to fail on be inaccurate.

- The measurement may not be made if the patient is suffering from an eye disease such as a cataract, retinal detachment, opaque condition of the cornea, crystalline lens, vitreous body etc.

- When the pupil is smaller than ϕ2.7 mm, the measurement may fail, or the correct values will not be obtained even if the measurement process is correctly made.

- When <S+C> is stronger than –18D~+22D, or when <C> is stronger than –8D~+8D, measurement cannot be made because these values are beyond the measurement range.

- If you do not fit the horizontal level of the measuring unit to the eye position, the cylindrical axis might not be set properly. Check the measuring unit position before looking into the view finder (For the automatic cylindrical axis compensation, fit the measuring unit position to the cylindrical axis).

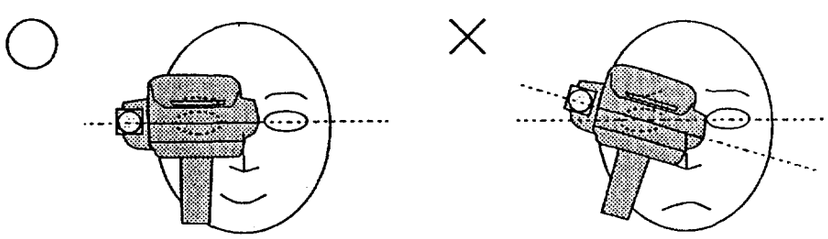


Figure 6-21

- When you move the unit, grip the unit firmly, with your armpit closed, to avoid blur. If you use the unit with your armpit opened, blur occurs easily.

Others

- Measurement with a contact lens on:
  Measurement is possible. However, if the contact lens is not properly fitted, the correct values may not be obtained. Any contamination or damage to the contact lens surface may result in a measurement failure.

- Measurement with eye glasses on:
  Measurement will be possible if the lens is at a slight angle. However, if the lens is at a substantial angle incline, the correct values will not be obtained. If light is reflected from the lens surface into the measuring window, or if the glasses have a colored lens with a low light transmission, the measurement may fail.

Precautions during the KER mode

- Do not turn toward bright light.
  When measuring near a bright window, light from the window reflects into the patient's eye and this will affect the measurement. In this case, move away from the window. Or measure with the patient's back to the window.
- Depending on the situation, if an illuminating lamp on the ceiling reflects into the patient's eye, the measurement may be bad. Slightly move the measurement position and remeasure the eye.
- Be careful so that the eye is not covered by the upper eyelid.
  Ask the patient to open his/her eyes wider, or have the patient or an assistant gently lift the eyelid with their finger.
- Outdoors, due to the reflection on the patient's eye, avoid measurement in the KER mode because it is difficult to operate. If this measurement is required, use a shade screen to block the light.

3) Printout

Use the printer provided with K-plus to print measured values.

(1) Install the print paper roll by using the procedure described in page 53.

(2) After measurement, aim the front of the measuring unit (see page 9) toward the light sensor window of the printer and then press the PRINT key. (You must hold the unit steady for a few seconds.)

Pressing the PRINT key sends data to the printer via infrared rays and generates a printout.

After the printer has received the measuring data, a beep sounds. Then the data light will illuminate for about one second.

The PRINT key functions are as shown on the Print Setting Screen (see page 48), Output Setting Screen (see page 52).

As for Eyeprint, it will be necessary to set EYEPRINT on Print Setting Screen.

When setting, eyeprint will be output after normal measuring output.

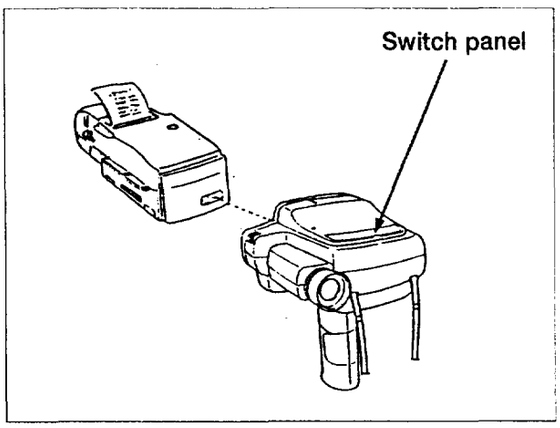


Figure 6-22

(3) The printer automatically outputs the paper, on which the measured values are printed. Remove the printout by pulling it downward.

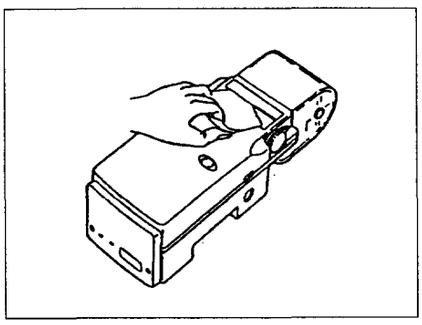


Figure 6-23

(4) Sample Printout (see page 38)

Note: On a printout, the measured values for the right eye always precede those for the left eye regardless if the left eye was measured first.

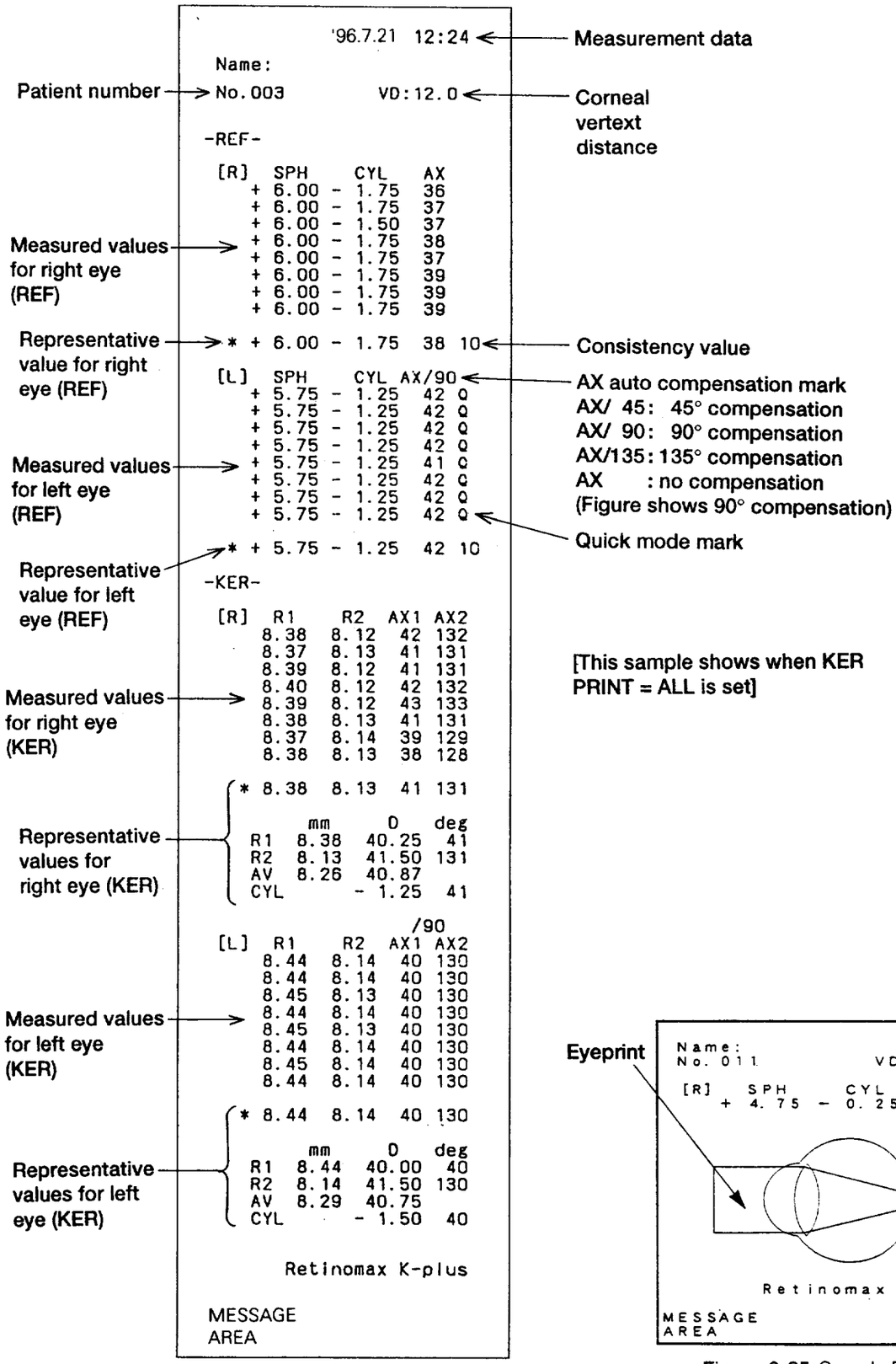

'96.7.21 12:24
Measurement data
Name:
Patient number
No. 003
VD: 12.0
Corneal vertext distance
-REF-
[R] SPH CYL AX
+ 6.00 - 1.75 36
+ 6.00 - 1.75 37
+ 6.00 - 1.50 37
Measured values for right eye (REF)
+ 6.00 - 1.75 38
+ 6.00 - 1.75 37
+ 6.00 - 1.75 39
+ 6.00 - 1.75 39
+ 6.00 - 1.75 39
Representative value for right eye (REF)
* + 6.00 - 1.75 38 10
Consistency value
[L] SPH CYL AX/90
AX auto compensation mark
AX/ 45: 45° compensation
AX/ 90: 90° compensation
AX/135: 135° compensation
AX : no compensation
(Figure shows 90° compensation)
+ 5.75 - 1.25 42 Q
+ 5.75 - 1.25 42 Q
+ 5.75 - 1.25 42 Q
+ 5.75 - 1.25 42 Q
Measured values for left eye (REF)
+ 5.75 - 1.25 41 Q
+ 5.75 - 1.25 42 Q
+ 5.75 - 1.25 42 Q
+ 5.75 - 1.25 42 Q
Quick mode mark
Representative value for left eye (REF)
* + 5.75 - 1.25 42 10
-KER-
[R] R1 R2 AX1 AX2
8.38 8.12 42 132
8.37 8.13 41 131
8.39 8.12 41 131
8.40 8.12 42 132
Measured values for right eye (KER)
8.39 8.12 43 133
8.38 8.13 41 131
8.37 8.14 39 129
8.38 8.13 38 128
[This sample shows when KER PRINT = ALL is set]
* 8.38 8.13 41 131
mm D deg
Representative values for right eye (KER)
R1 8.38 40.25 41
R2 8.13 41.50 131
AV 8.26 40.87
CYL - 1.25 41
/90
[L] R1 R2 AX1 AX2
8.44 8.14 40 130
8.44 8.14 40 130
8.45 8.13 40 130
Measured values for left eye (KER)
8.44 8.14 40 130
8.45 8.13 40 130
8.44 8.14 40 130
8.45 8.14 40 130
8.44 8.14 40 130
* 8.44 8.14 40 130
mm D deg
Representative values for left eye (KER)
R1 8.44 40.00 40
R2 8.14 41.50 130
AV 8.29 40.75
CYL - 1.50 40
Retinomax K-plus
MESSAGE AREA

Figure 6-24 Sample Printout

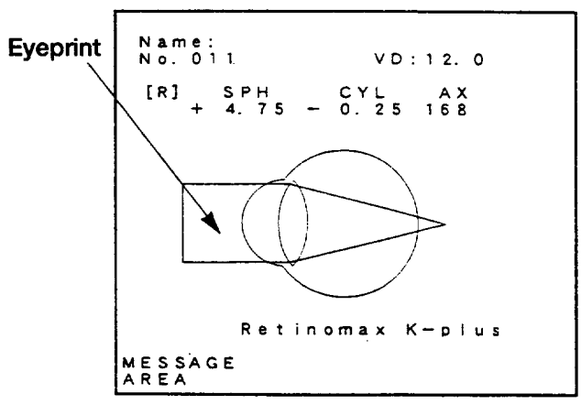
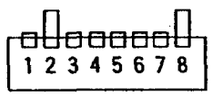
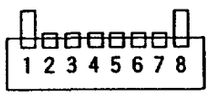
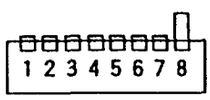


Figure 6-25 Sample Printout of Eyeprint

(5) When the printer cannot operate normally (for reasons such as the passing of a person between the measuring unit and the printer while data is being sent) the printer data lamp will illuminate yellow color and a beep sounds. The printer will not operate if infrared rays do not reach it. In this situation, get closer to the printer and press the PRINT key again.
Data can be printed any number of times until the next measurement is performed or unit is turned off.

Setting the printer DIP Switch

When using two or more printers in a room, the DIP switch settings(see Figure 6-26) of each printer should be set as shown in the following figure to prevent interference between the two units.
The printer addresses will be matched to the measuring unit addresses (see Figure 6-27).

Address	Setting of DIP switch
1 (initial setting)	
2	
3	
4	

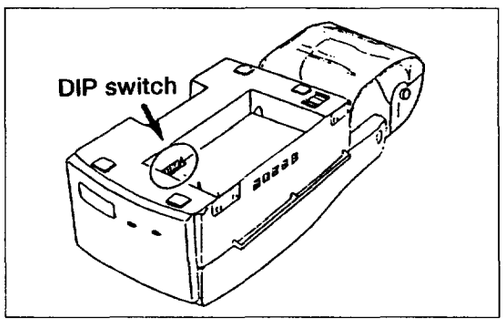


Figure 6-26

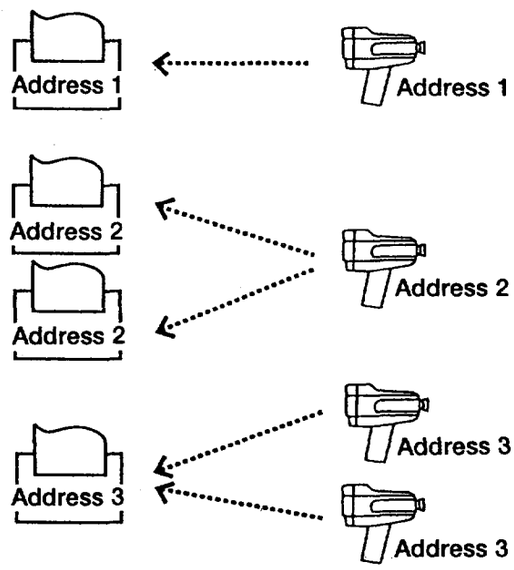


Figure 6-27 Sending of Data from Measuring unit to Printer

Representative values (for REF)

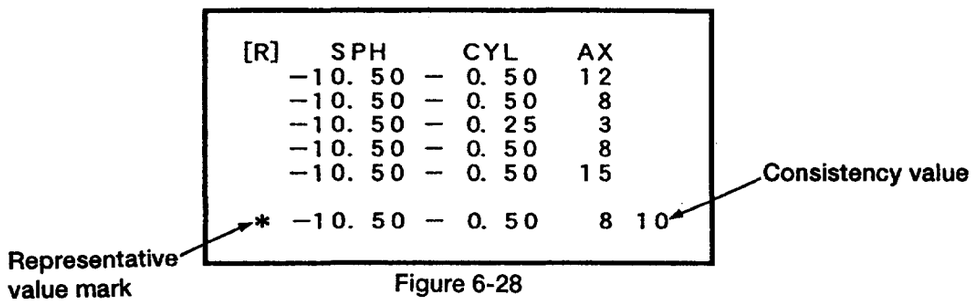


Figure 6-28

An asterisk (*) indicates the representative values on a printout.

Representative Value: A guide to help you choose which of several measured values for one eye to use after the measurement cycle.

When selecting one of the measured values that vary widely, consider the following:

- Substantial variance of SPH values:

  The patient's eye may be accommodating.

  It is also recommended that you remeasure the eye carefully again.

- Substantial variance of CYL and AX values:

  The AX values may tend to vary somewhat when the eye is weak astigmatically (CYL value of less than 0.5D).

  Other causes may include:

  - Eyelashes are occluding the pupil.
  - The pupil diameter is less than ϕ2.7 mm.
  - An opaque eye or an irregular astigmatic eye.

  When any of these three situations occurs, normally the accuracy of the measured values will be low. If the eyelashes or pupil diameter affect the measurement (see page 35), you should re-measure the eye paying close attention to these factors.

Consistency value (for REF)

Consistency value shows the degree of variance of the measured values. It is indicated at the right side of the printout.

- Normally 8 or more indicates a measurement with small variance.
- In case of 7 or less, the measurement values show variance. The handling of the measured values require sufficient attention.
- The consistency value is printed out only when the measurement in the REF mode is performed 3 or more times.

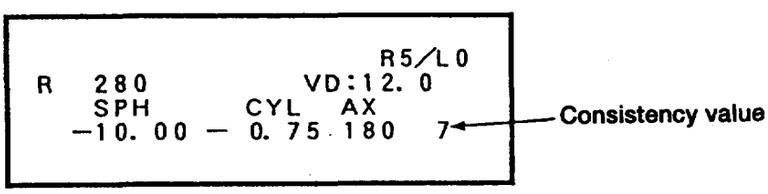


Figure 6-29

Battery operation of the Printer

When you use the printer separately from the station, use the printer battery (optional) (complete the reversal of the steps shown in Figure 5-10 in page 22) and install the battery pack into printer.
After you install the battery pack into printer, the printer BATTERY lamp will be illuminated.
The color of the lamp indicates the batteries charge level as shown in the following table:

Color of BATTERY lamp	Charge level
Green	Charge level is enough.
Alternating illumination of the green and yellow lamp	Charge level becomes lower. If you connect the printer with a low battery to the station, the charge lamp illuminates and the battery charge starts automatically on the station.

When the printer operates by station power, the lamp lights up in Green only and does not show the status of charge level.

Note: ① The conventional Retinomax printer cannot be used for the Retinomax K-plus.
② When you remove the printer from the station, installing the batery in printer, printer power may go off.
This is not unusual.
You can use the printer turning the printer power switch ON again.

4) Kerato-peripheral Measurement (PERI)

(1) Press the PERI key. The mode changes to the kerato-peripheral measurement and the screen switches.

(2) With the Mire ring and the alignment mark roughly aligned, press the READY key (Start switch). (Same as with the normal kerato-measurement.) The light blinks and measurement is repeated.
Peripheral measurements at the center and in the horizontal direction are repeated in turn.

(3) After repeating the measurement several times, press the READY key. The measurement completes and the cursor moves downward.

When the peripheral measurement in the horizontal direction is completed and the vertical measurement is not necessary, press the PRINT key to complete the operation and print out the data.
When the PRINT key is pressed, all values measured in the REF, KER and KER-Peripheral will be printed out.

When a measurement in the vertical direction is also necessary, move to the next measurement without pressing the PRINT key.

Measurement in the vertical direction
① Confirm that the cursor is as indicated in Figure 6-32, and make sure the upward mark is located at the top.
Measure by rotating the measuring unit by 90° (direction of Figure 6-32).
② Measurement procedures are the same as for the horizontal direction.
③ After repeating measurement several times, press the PRINT key.

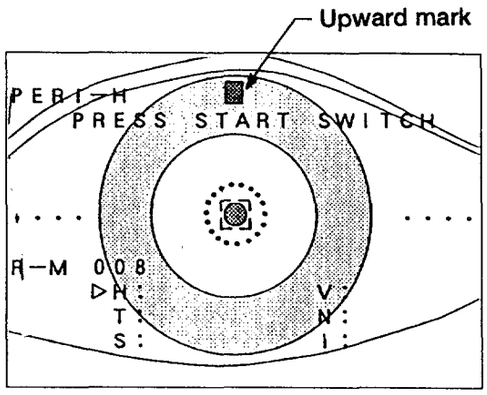


Figure 6-30

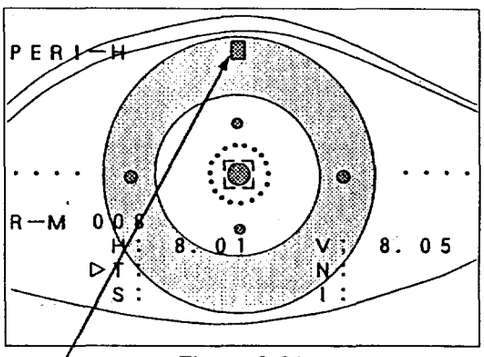


Figure 6-31

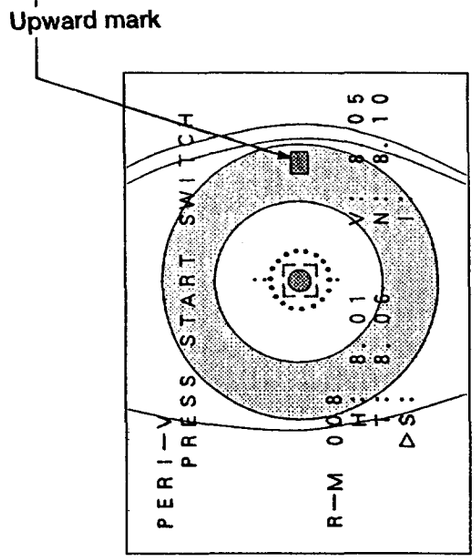


Figure 6-32

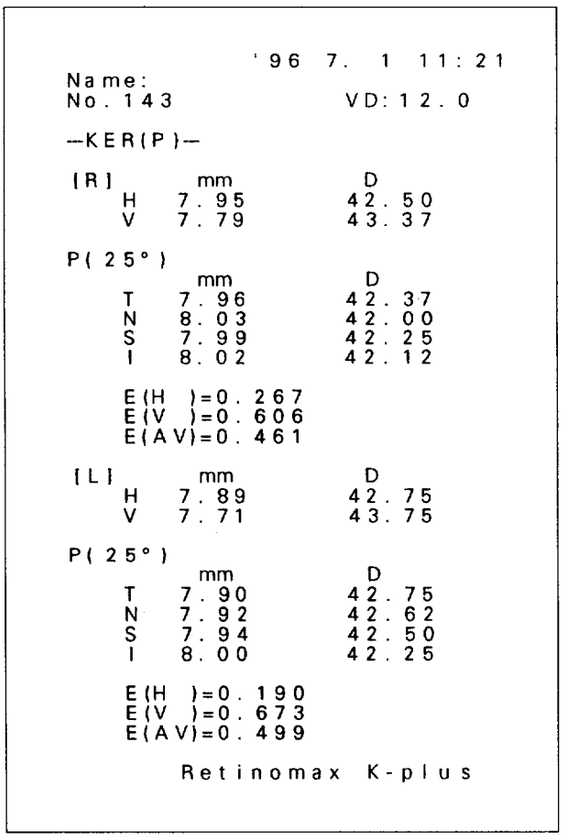


Figure 6-33 Sample of PERI Print

Precautions

① During the peripheral measurement, right or left is identified manually.

② When measuring in the vertical direction, do not use the forehead rest.
(It touches the other eye of the patient.)

③ When measuring in the vertical direction, if eyelashes and upper eyelid block the measurement light, measurement may be bad.
Measure the eye after the patient opens his/her eye widely.

5) Retro mode (RETRO)

In case of the following ① or ②, if the Retro mode is selected, it is easy to see the inside of the pupil and useful to understand the measurement condition.

① The measured values vary widely .

② The consistency value is low.

(1) Press the RETRO key. The mode changes to Retro and the screen switches. Once entered into the Retro mode, the target illumination automatically changes to L.

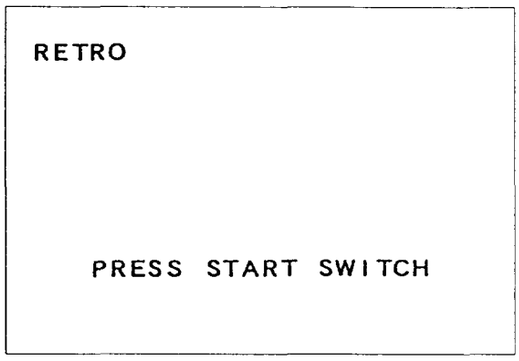


Figure 6-34

(2) Press the READY key.
The central light spot changes to the illumination condition. The anterior segment illumination (light to illuminate an anterior segment such as the iris) is turned off.
When there is foreign matter disturbing the measurement light, such as an opacity of the lens, it shows up as a black shadow on the screen.

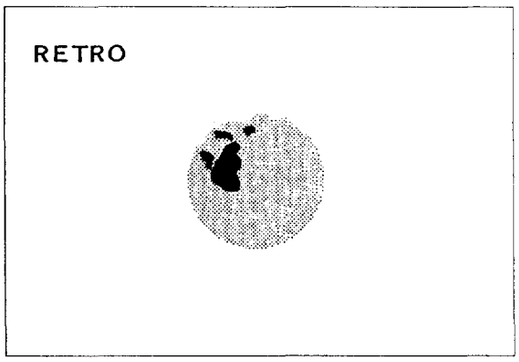


Figure 6-35

- There may be a case that it can be seen better if the center is shifted. Especially, if there is any opacity on the center, there may be a case that it cannot be seen clearly unless the light enters, escaping from the opacity.
- When a light from the outside (e.g. illumination of fluorescent lighting) reflects into the patient's eye, there may be a case that it cannot be seen well. Take measures so as not to reflect the external illumination.

(3) When the READY key is pressed, it returns to the condition of item (1).

(4) It returns to the measuring mode by pressing the RETRO key.

6) Measuring hard contact lens base curve

(Base curve of a soft contact lens cannot be measured.)

(1) Place several drops of water on the hard contact lens holder. (Figure 6-36)

(2) Place the hard contact lens on the holder (face the side to be measured toward the unit). (Figure 6-37)

(3) Using the normal kerato-measurement method, measure from the top. (Figure 6-38)

Note: When the room is too bright and the contact lens edge shines, there may be a case that the measurement value becomes unstable.

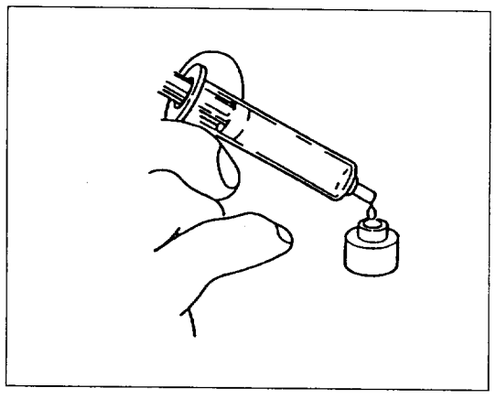


Figure 6-36

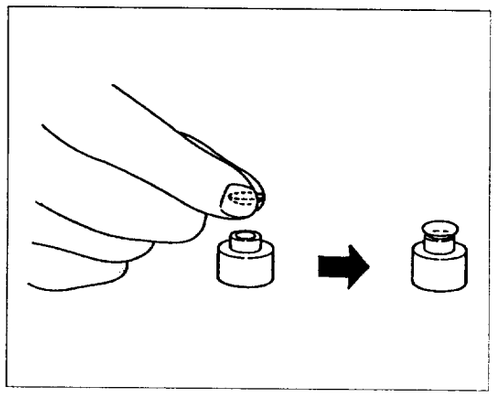


Figure 6-37

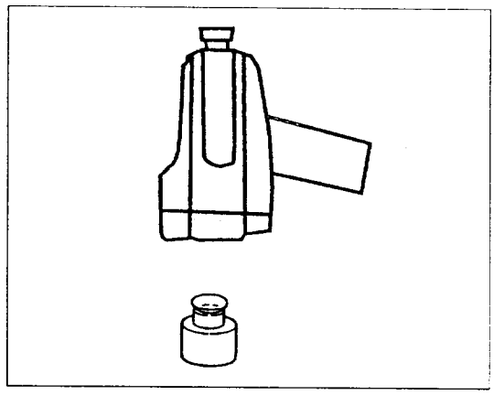


Figure 6-38

7. Initial Settings

In Retinomax K-plus, the following initial settings are possible.

1) Initial Setting (SETUP) Screen

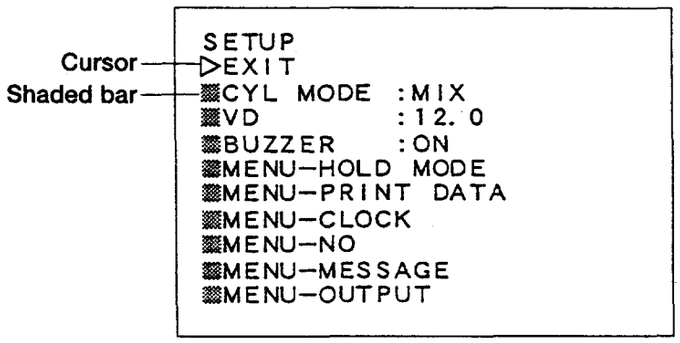


Figure 7-1

This initial setting (SETUP) screen is displayed by turning ON the instrument while simultaneously pressing MODE key.

On this screen, you can move the cursor (▷) down (by pressing the R/L key) and up (by pressing the Angle key) to select an item, and press the PRINT key to change the value or change the submenu. The cursor moves along the shaded bar.

Move the cursor to one of the following items and press the PRINT key to display each value of that item in sequence. The selected value becomes effective when you exit from this screen.

Item	Function	Format
EXIT	Switches to the measurement mode.	---------
CYL MODE	Changes the astigmatism mode.(−/+/±)	MINUS→PLUS→MIX
VD	Sets the base VD for glasses.	12.0→13.5→13.75→14.0→15.0→16.0→0.0
BUZZER	Selects the ON/OFF of the message printing.	ON→OFF

Submenu	Function	Menu Opened
MENU-HOLD MODE	Sets the Initialize	Initialization setting screen
MENU-PRINT DATA	Selects the print mode	Print setting screen
MENU-CLOCK	Sets the clock	Clock setting screen
MENU-NO	Sets the patient number	Patient number setting screen
MENU-MESSAGE	Specifies the printout message	Message input screen
MENU-OUTPUT	Sets the output device	Output setting screen

2) Initialization Setting Screen

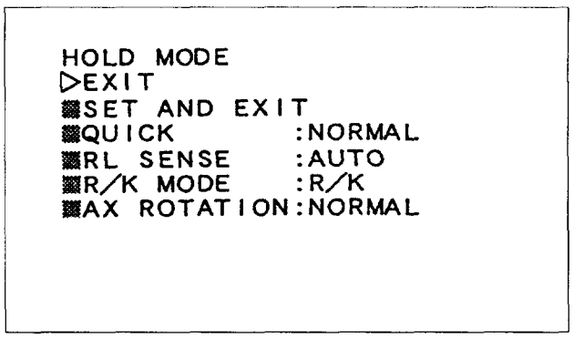


Figure 7-2

This screen allows you to set the function which disables a part of initialization when turning on the power and printing out.

Item	Symbol	Function
EXIT	-----	Returns to the SETUP screen.
SET AND EXIT	-----	Saves the revised data and returns to the SETUP screen.
QUICK	HOLD	Retains the previous QUICK mode when initializing.
	NORMAL *	Cancels QUICK when initializing.
RL SENSE	MANUAL	Sets always as manual for RL identification.
	AUTO *	Sets as automatic for RL identification when initializing.
R/K MODE	HOLD	Retains the previous mode when initializing.
	R/K *	Sets as the REF/KER mode when initializing.
AX ROTATION	HOLD	Retains the previous mode when initializing.
	NORMAL *	Cancels the Ax compensation mode when initializing.

An asterisk (*) indicates the initial factory setting.

3) Print Setting Screen

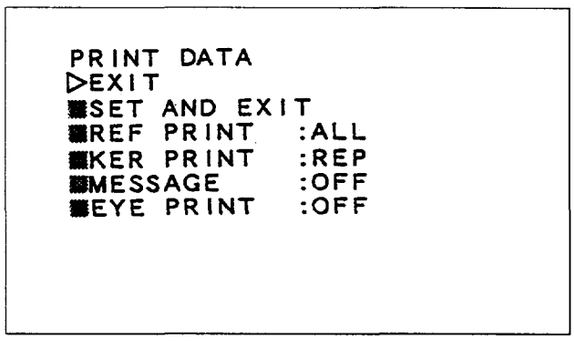


Figure 7-3

This screen allows you to set the print related items.

Item	Symbol	Function
EXIT	-----	Returns to the SETUP screen.
SET AND EXIT	-----	Saves the revised data and returns to the SETUP screen.
REF PRINT	ALL *	Prints out all the data measured in the REF mode.
	REP	Prints out only the representative values measured in the REF mode.
	OFF	Does not print out.
KER RPINT	ALL	Prints out all the data measured in the KER mode.
	REP *	Prints out only the representative values measured in the KER mode.
	OFF	Does not print out.
MESSAGE	ON	Prints out the print messages.
	OFF *	Does not print out.
EYE PRINT	ON	Prints out the eye print.
	ON BY SW	Prints out the eye print by pressing the PRINT key one second.
	OFF *	Does not print out.

An asterisk (*) indicates the initial setting.

4) Clock Screen

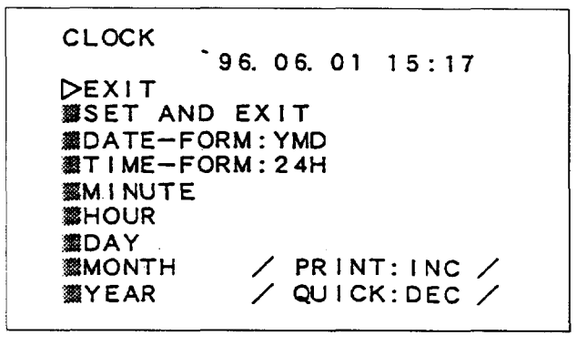


Figure 7-4

This screen allows you to set the internal clock and specify the format of the date on a printout. The following table lists the items and functions.

Item	Function	Format
EXIT	Returns to the SETUP screen.	-----
SET AND EXIT	Saves the revised data and returns to the SETUP screen.	-----
DATE-FORM	Specifies the date format.	MDY→DMY→YMD
TIME-FORM	Specifies the time format (24-hour or 12-hour format).	24H→AM/PM

On this screen, the PRINT and QUICK keys have the special functions that are shown in the following table.

Item	PRINT key	QUICK key
MINUTE	Incremented by a minute.	Decremented by a minute.
HOUR	Incremented by an hour.	Decremented by an hour.
DAY	Incremented by a day.	Decremented by a day.
MONTH	Incremented by a month.	Decremented by a month.
YEAR	Incremented by a year.	Decremented by a year.

When you select a date or time format, the date displayed at the top of this screen changes accordingly.

DATE-FORM	TIME-FORM	Example
YMD (year, month, day)	24H	'96 03. 15 21 :27
YMD (year, month, day)	AM/PM	'96 03. 15 09 :27 PM
MDY (month, day, year)	24H	03. 15 '96 21 :27
MDY (month, day, year)	AM/PM	03. 15 '96 09 :27 PM
DMY (day, month, year)	24H	15. 03 '96 21 :27
DMY (day, month, year)	AM/PM	15. 03 '96 09 :27 PM

5) Patient Number Setting Screen

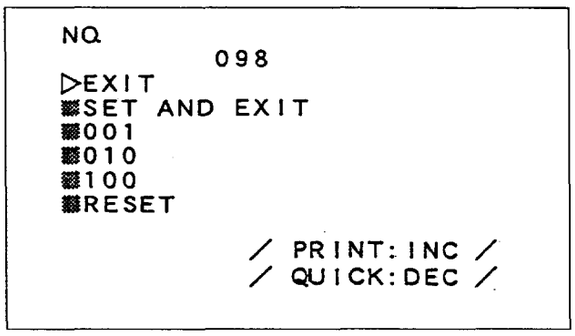


Figure 7-5

This screen allows you to set the patient number.
The range of the patient number is between 001 and 999.

Item	Function	Example
EXIT	Returns to the SETUP screen.	-----
SET AND EXIT	Saves the revised data and returns to the SETUP screen.	-----
001	PRINT key : Increments the number by 1. QUICK key : Decrements the number by 1. ※	097→098 097→096
010	PRINT key : Increments the number by 10. QUICK key : Decrements the number by 10.	097→007 097→087
100	PRINTkey : Increments the number by 100. QUICK key : Decrements the number by 100.	097→197 097→997
RESET	PRINT key : Resets the number to 001.	097→001

※ 001 remains if pressing QUICK key at 001.

6) Message Input Screen

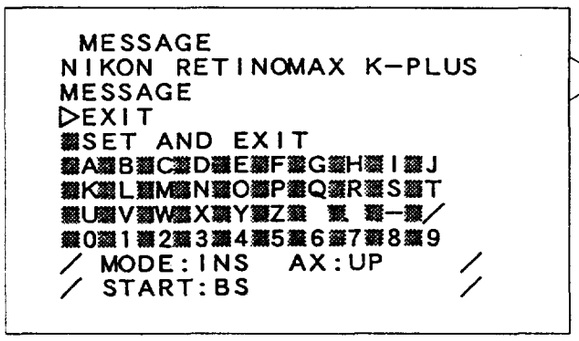

MESSAGE
NIKON RETINOMAX K-PLUS
MESSAGE
▷EXIT
SET AND EXIT
A B C D E F G H I J
K L M N O P Q R S T
U V W X Y Z - /
0 1 2 3 4 5 6 7 8 9
/ MODE:INS AX:UP /
/ START:BS /
Message area

Figure 7-6

This screen allows you to create a message that will appear on the end of he printouts.
Enter the message in the message area (the second and third lines).

Characters that can be entered are as follows, alphabetic letters, numbers, space, period, minus sign, and slash.
You can enter up to 48 characters (24 characters per line).
When the cursor (▷) is positioned to either of the following two items, this screen can be used in the same way as the other screens.

Item	Function	Format
EXIT	Returns to the SETUP screen.	- - - - -
SET AND EXIT	Saves the revised message and returns to the SETUP screen.	- - - - -

When the cursor is in the character list, the following keys can be used to move the cursor and enter or delete a character.

MODE key	READY key	PRINT key	R/L key	Angle key
Enters a character at the cursor position.	Deletes a character preceding the cursor.	Moves the cursor to the right.	Moves the cursor down.	Moves the cursor up.

Pressing the Angle key when the cursor is located at the top line of the character list moves the cursor to the "SET AND EXIT". Pressing the R/L key when the cursor is located at the bottom line of the character list moves the cursor to the "EXIT" position. Pressing the PRINT key when the cursor is located at the last character of a line moves the cursor to the first character of the same line.

7) Output Setting Screen

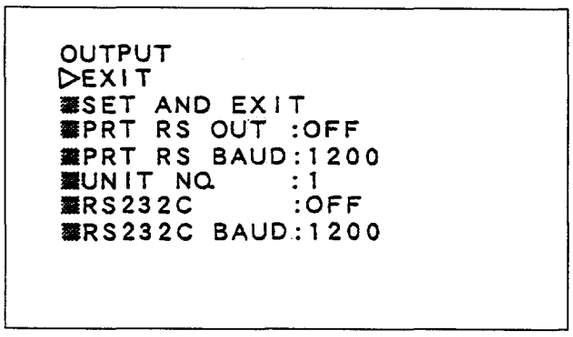


Figure 7-7

This screen allows you to define an output device.

● PRT RS OUT

You can designate which data is sent when the communication port of the printer is used to transmit the data to the external equipment.

REF : Sends REF measured data from the printer RS232C.
KER : Sends KER measured data from the printer RS232C.
REF/KER : Sends both REF and KER measured data from the printer RS232C.
OFF : Does not send data from the printer RS232C.

Note: When transmitted to the Nikon Autooptester OT-3A, OT-5A, OT-7A and OT-8A, select REF.

● PRT RS BAUD

You can set the transmission speed when transmitting from RS232C port of the printer unit.

1200: Sends at 1200 bps of the printer communication port
9600: Sends at 9600 bps of the printer communication port

Note: When transmitted to the Nikon Autooptester OT-3A, OT-5A, OT-7A and OT-8A, select 1200.

● UNIT NO.

You can assign a unique address to each printer to prevent interference when two or more printers are used. Four addresses (1 through 4) can be assigned.

* The address of the initial setting is "1." The address of the printer unit is also set as "1."

When setting an address other than "1," it is necessary to match the DIP switch of the printer unit to the address. For the setting method of the printer DIP switch, refer to page 39.

● RS232C

You can select which data is sent by using RS232C port which is built-in the measuring unit.

REF : Sends the REF measured data from the measuring unit RS232C.
KER : Sends the KER measured data from the measuring unit RS232C.
REF/KER : Sends both REF/KER measured data from the measuring unit RS232C.
OFF : Sends no data from the measuring unit RS232C.

Note: When transmitted to the Nikon Autooptester OT-3A, OT-5A, OT-7A and OT-8A, select REF.

● RS232C BAUD

You can set the transmission speed when transmitting from RS232C port of the measuring unit.

1200: Sends at 1200 bps from the measuring unit RS232C.
9600: Sends at 9600 bps from the measuring unit RS232C.

Note: When transmitted to the Nikon Autooptester OT-3A, OT-5A, OT-7A and OT-8A, select 1200.

8. Maintenance

1) Replacing Paper Roll

① When the print paper nears the end of the roll, a red line will appear on both sides of the paper. This indicates that it is now time to replace the paper roll.
Turn the printer upside down. Open the paper holder cover and pull the two paper holder knobs outward.
Pull down the release lever and remove the paper roll.

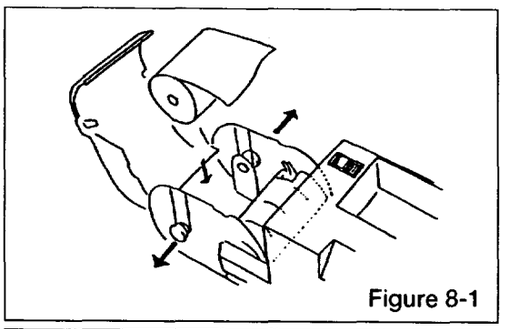


Figure 8-1

② Remove the shipping tape from the new paper roll (see Figure 8-2).

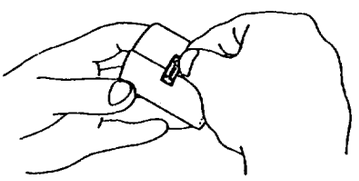


Figure 8-2

③ Pull out the paper one revolution of the roll and fold it (see Figure 8-3).

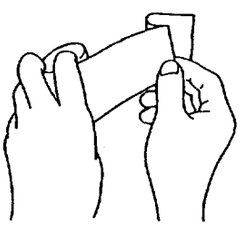


Figure 8-3

④ Then gently tear the paper along the fold (see Figure 8-4).

(The purpose of this process is to avoid printing on the adhesive remaining after the securing tape has been removed, and to make the paper roll easier to insert into the paper slot.)

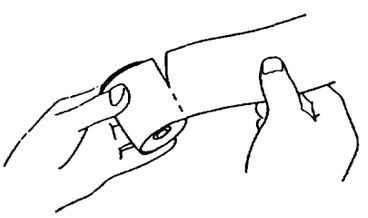


Figure 8-4

⑤ Install the paper roll as shown in Figure 8-5 and fasten into place the paper roll core with the paper holder knobs. Lever should be in the upward position during paper loading.

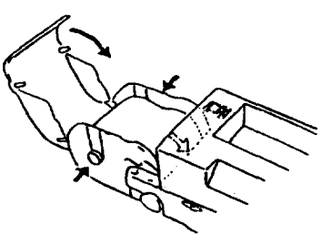


Figure 8-5

⑥There are two ways to operate the unit. The first way is by AC Voltage operation, please refer to procedure (A) . The second way is by battery operation, please refer to procedure (B).

Procedure (A) AC Voltage operation

⑦ Insert the edge of the paper into the paper slot.

⑧ Pull down the release lever. Turn the paper feed knob to feed it through the opening. The paper is automatically fed out from the outlet. If the paper is fed out at an angle, pull down the release lever and manually straighten the paper.
Press the release lever in the front direction.

⑨ Close the paper holder cover by pushing it down until it clicks.

⑩ Connect the printer with the station.

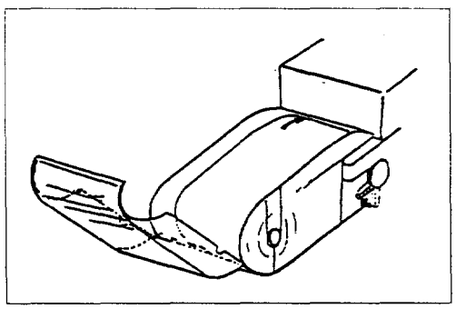


Figure 8-6

Procedure (B) Battery operation

⑦ Press the release lever in the front direction. In this case, the buzzer beeps continuously because the tray contains no paper. The buzzer stops beeping when you set paper in the tray.

⑧ Insert the edge of the paper into the paper slot. The paper is automatically fed out from the outlet. If the paper is fed out at an angle, pull down the release lever and manually straighten the paper.
Make sure that the release lever is in the look position.

⑨ Close the paper holder cover by pushing it down until it clicks.

Note : Do not insert the paper upside down. Due to the fact thermal paper prints only on one side.

2) Fuses Replacement

After turning on the power switch of the station, if the power lamp does not light up, it is possible that the fuses may have blown.

> **⚠ Caution**
>
> To check the fuses, first turn the unit OFF by the power switch and then disconnect the power cable from the wall outlet.

Press inward on the tabs on both sides of the fuse holder with a small flat-blade screwdriver and pull it out. Remove the two fuses from the fuse holder and check if they have blown. If so, replace the fuses with the recommend fuses.

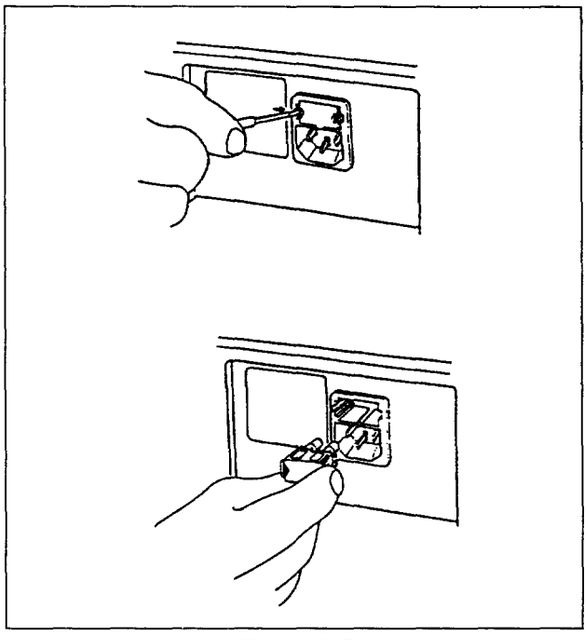


Figure 8-7

Use the recommended fuses only:
Please place an order with your local Nikon dealer for spare replacement fuses.

For AC 100V/120V area:	Time-delay fuse 125V 2A φ5.2 x 20 mm	
	type NAGASAWA ELECTRIC WORKS, LTD.	"SB2"
	or NIPPON SEISEN	"FBT"
For AC 230V area:	Time-delay fuse 250V 1A φ5.2 x 20 mm	
	type NAGASAWA ELECTRIC WORKS, LTD.	"S3-1000"
	or HAMAI DENKYU	"TDI-1A"

3) Cleaning the Forehead Rest

Periodically wipe the surface of the forehead rest with a soft cloth or tissue paper moistened with lens cleaning liquid or ethyl alcohol.

4) Cleaning the Measuring Window/KER Measuring Window

The measuring window and KER measuring window have a dust protection glass or filter. If any dust on the glass is visible from the patient side, use the blower provided to remove the dust by powerfully blowing air several times. If the dust cannot be removed, gently wipe the measuring window with a soft and clean cotton cloth (such as gauze) moistened with pure alcohol.
For details on the cleaning, consult with your dealer.

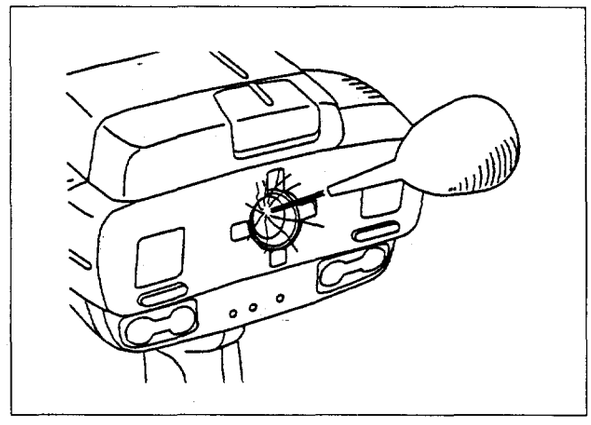


Figure 8-8

⚠ Caution Because the dust-resistance glass is fragile, do not press on it too hard!

5) Model Eye

When correct measured values cannot be obtained with the model eye, that was provided its lens surface could possibly have become contaminated by dust or a finger print. Use the blower that was provided to blow air to remove the dust. If necessary, gently wipe the model eye with a soft clean cotton cloth (such as gauze) moistened with a little cleaning solution or absolute alcohol being careful not to scratch it. (Never use a handkerchief or absorbent cotton wool.)
A microscopic scratch on the lens surface of the model eye may reduce the accuracy of its measurement. Be careful not to place the model eye against a hard surface or drop it on the floor as either may cause damage.

9. Connection with External Device

The printer has an interface connector complying with EIA RS-232C (see page 8). This connector can be used to send measured values to an external device such as the Nikon Auto Optester.
If Retinomax K-plus is connected with the Nikon Auto Optester OT-3A, OT-5A, OT-7A or OT-8A, the objective measurement data may be automatically loaded into the Optester for a faster and more efficient subjective examination.

For more information about the interface connection, consult with your Nikon dealer.

10. Using AC-adapter P-400 (Option)

When you use AC-adapter P-400 and DC-cord of option, the measuring unit drive for AC-adapter P-400.

Nomenclature

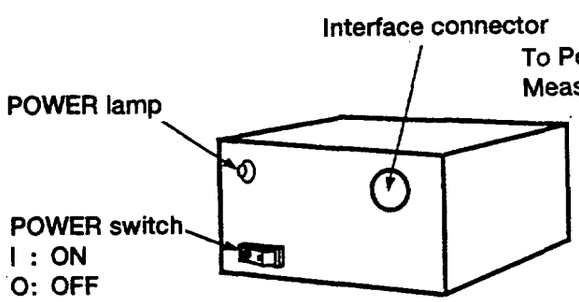


Figure 10-1

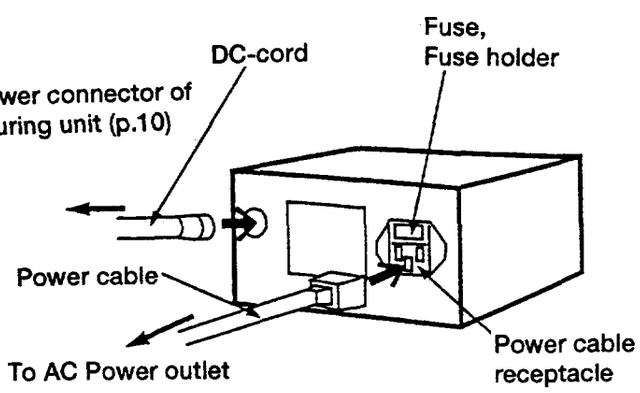


Figure 10-2

Method

Make sure that the power switches of the measuring unit and AC-adapter P-400 is set to OFF, and set the AC-adapter P-400 as shown in the figure 10-2.
When you use the AC-adapter P-400, turn the AC-adapter P-400 power switch on. Then, the measuring unit use the AC adaptor as the power supply.
Also, the measuring unit can communicate by inserting the communication cable of option in the interface connector. This cable can be used to send measured values to Nikon Auto Optester and a personal computer. At this time, please make setting RS232C "REF" referring to page 52.
After using the AC-adapter P-400 be sure to turn it OFF.

Use the recommended fuses only:		
Please place an order with your local Nikon dealer for spare replacement fuses.		
For AC 100V/120V area:	Time-delay fuse 250V 500mA ϕ5.2 x 20 mm	
	type NAGASAWA ELECTRIC WORKS, LTD.	ES2-0500
For AC 230V area:	Time-delay fuse 250V 200mA ϕ5.2 x 20 mm	
	type Bussmann Cooper (U.K.) Ltd.	S504

11. Troubleshooting

If any problems occur on Retinomax K-plus, inspect it by using the following table before calling for repair.

Measuring unit

Problem	Check Point	Cause and Action
The power lamp does not light up when turning the K-plus on.	It seems that the battery pack has been fully discharged.	The battery pack may have been fully discharged when the Retinomax K-plus was delivered or has not been used for a long time. Charge the battery pack.
The battery pack cannot be inserted into the measuring unit.	Are you incorrectly installing the battery pack possibly backwards?	Check if the battery pack is in the correct direction (see page 19).
The KER measurement mode cannot be used. The KER measured values are widely varied.	Is there any disturbance of external light from peripheral? Does the eyelid cover the eye?	Make the room darker. Do not face the window during measurement. Close the blind of the window. Lift the eyelid.
The RER measurement mode cannot be used. The RER measured values are widely varied.	Does it exceed the range? Is there any foreign matter to obstruct the light inside the pupil?	Confirm by the Retro mode.

Station

Problem	Check Point	Cause and Action
The charge lamp flickers during charging or renewing.	Check this operation according to the procedure described in "7), (4) in page 25."	If you find a problem in the check described in "7) , (4) in page 25", call your local Nikon dealer.

Printer

Problem	Check Point	Cause and Action
The printer when connected with the station is turned ON but does not operate.	① Is the station turned off when you do not set the battery in the printer ? ② Is the printer connected to the station correctly ?	① When the printer is connected with the station, it will not operate unless the station is ON. Turn the station on. ② Refer to "Figure 5-10 in page 22" to connect the printer to the station correctly.
Although the battery pack has been installed in the printer, it is turned ON but the power lamp does not light up.	① Is the battery pack installed backwards? ② Does the battery lamp light alternate between green and yellow?	① Check if the battery pack is in the correct direction (see page 21). ② Charge the battery pack.
The printer power lamp flickers.	① Is the battery pack nearly empty? ② Is the paper roll correctly installed? (Buzzer beeps) ③ Is the printer release lever still up?	① Charge the battery pack. ② See "8. Maintenance" (page 53) to reinstall the paper roll. ③ Push the printer release lever down.
A continuous beeping sound	① Is the paper correctly installed? ② Is there good RS-232C connection with an external device or is the external device working properly?	① Re-insert the paper correctly referring "8 Maintenance" (page 53). ② Make sure the interface cable is properly connected on both ends. Read the external device manual carefully.
There is no printout.	① Did you use the correct printer paper? ② Is the printer release lever still up? ③ Is the paper roll inserted upside down?	① Use the recommended printer paper. ② Push the printer release lever down. ③ See "8. Maintenance" (page 53) to reinstall the paper roll.
The printer does not receive measurement data sent from the measuring unit.	① Is there any obstruction between the measuring unit and the printer ? ② Does the measuring unit address correspond with the printer address?	① Remove the obstruction or place the equipment in a location which does not have any obstruction. ② Check the setting on the Output setting screen (see page 52) and the printer DIP switch (see page 39) and make sure the two addresses match.

Problem	Check Point	Cause and Action
Characters are printed with little space set among them. Paper is not be fed smoothly.	① Is paper set properly ? ② Does the paper cover press paper strongly ?	① Refer to "1) Replacing Paper Roll" in page 53 to set paper in the tray properly. ② Press the paper holder knob up to the appropriate position to protect excessively high pressure from being applied to paper.

12. Specifications

Retinomax K-plus measuring unit

- **Automatic REF Measurement Section**

Measurement range S+C : −18.00 ~ +22.00D (0.25D step, case VD=12.0)
C : −8.00 ~ + 8.00D (0.25D step, case VD=12.0)
AX : 1 ~ 180° (1° step)
Measurable minimum pupil diameter
: ϕ 2.7 mm

- **Automatic KER Measurement Section**

Measurement range : Curvature : 5.50 to 11.00 mm (0.01 mm step)
Corneal astigmatism: 0.00 to −12.00 D (0.12 D step)
Astigmatism axis : 1 to 180° (1° step)
Measurement area : Center : 3.2 mm diameter (when R 8 mm)
Peripheral: horizontal and vertical two step measurement in tangential 25° direction
Mire ring : 30 mm diameter 18 dots LED

- **Others**

Corneal vertex distance : Selectable from 12, 13.5, 13.75, 14.0, 15.0, 16.0, 0.0 mm
Measurement mode : Automatic REF/KER, Automatic REF, Automatic KER
Measurement time : Automatic REF/KER measurement
Approx. 0.27 sec. (measurement time up to display)
Automatic REF measurement
Approx. 0.005 sec. (measuring value storing time)
Approx. 0.2 sec (entire measurement time up to display)
Automatic KER measurement
Approx. 0.033 sec. (measuring value storing time)
Approx. 0.1 sec. (measurement time up to display)
Continuous measurement time : Approx. 1 hour (when fully charged)
Automatic shutoff : K-plus is automatically turned OFF if no operation is done for 3 minutes.
View finder : 0.6 inch, monochrome
Fixation target : Landscape chart
Right and left eyes identification : Automatic and manual can be switched.
Automatic R/L reading is possible in during normal measurement from the front.
Output : Exclusive external printer (infrared communication)
RS-232C Interface
Power method : Battery-drive (when the battery pack is installed)
AC adapter-drive (when the optional AC adapter and DC cord are used)
Battery : Nickel-metal hydride battery (DURACELL DR10)
Working time: About 1 hour with each full charge
Charging time: About 1.5 hours
Weight : 1,020g (excluding battery pack)
1,200g (including battery pack)
Dimensions : 163 (w) x 226 (h) x 236 (d) mm

• Battery Operation

Rated Voltage	: DC6V
Rated Current	: DC1.5A
Classification	: Internaly Powerd, Type B

• AC-Adapter Operation

Rated Voltage	: AC100V/120V/230V
Rated Frequency	: 50/60Hz
Rated Current	: 0.2A/0.18A/0.1A
Classification	: Protection Class II, Type B
Fuse	: 200mA250V (AC230V area) 500mA230V (AC100V/120V area)

Retinomax K-plus station

Battery charge	: Automatic and manual charge are possible.
Power supply	: 100 VA
Fuse	: Time-delay fuse 125V 2A (ϕ 5.2 x 20 mm) for 120V Time-delay fuse 250V 1A (ϕ 5.2 x 20 mm) for 230V
Weight	: 1,250g
Dimensions	: 179 (w) x 105 (h) x 257 (d) mm

Retinomax K-plus printer

Print paper width	: 58 mm
Power method	: AC Power when connected with the station Battery-drive (when separated from station and a battery pack is installed)
Battery	: Nickel-metal hydride battery (DURACELL DR10) Working time : About 1 hour with each full charge Charging time : About 1.5 hour
Input	: Exclusive external printer (infrared communication)
Output	: External eye examination machine or a computer RS232C (external connector)
Weight	: 770g (excluding battery pack, including print paper)
Dimensions	: 93 (w) x 77 (h) x 266 (d) mm

Battery pack

Battery	: Nickel-metal hydride battery (DURACELL DR10)
Nominal voltage	: DC 6 V
Nominal capacity	: 1500 mAhr
Weight	: 180g
Dimensions	: 46 (w) x 18.2 (h) x 89.3 (d) mm

13. Index

A

address 39
Anterior illuminating window 9
automatic fogging mechanism 31

B

battery box 13, 21
battery pack 18

C

CHARGE key 12, 23
Clock screen 49
consistency value 40
cylindrical power 26

D

DIP switch 39

F

forced charging 24
forehead rest 9, 34
fuse 55

G

grip 10

H

Hard contact lens 45
horizontal eye position target line 9, 28

I

IOL eye 31
Initial Setting (SETUP) screen 46
Initialization Setting Screen 47

L

left eye lamp 11, 32

M

measuring unit (operator side) 10
measuring unit (patient side) 9
measuring unit switch panel 11
measuring head 9
measuring window 9
message area 61
model eye 51

O

Output setting screen 52

P

package contents 8
Patient Number Setting screen 50
POWER switch 11
power lamp 11
power connector 10
power saving 31
PRINT key 11
printer 13
print message 46, 48

Q

QUICK key 11, 47
quick mode 11, 33

R

READY key (Start switch) 9, 42
renewing the battery pack 23
representative value 40
Retro mode 44
right and left eyes sensor 9
right eye lamp 11, 32
R/L automatic identification lamp 11
R/L key 11, 32
rubber pad 9

S

setting the base VD for glasses 46
spherical power 26
Start switch 9, 42
station 12
strap bracket 10
switch panel 10, 11

T

target brightness key 11
time display format 49

V

vertical eye position target line 9, 28
view finder 10